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2. DESCRIPTION OF THE ACTION UNDER CONSULTATION

This chapter summarizes and describes the federal action under consultation, which encompasses the continued operation of the Willamette Project and related activities. The Willamette Project is comprised of thirteen USACE dam facilities and associated impoundments that are operated both as a system and independently to meet a number of purposes and needs.

The action under consideration potentially influences a large area of the Willamette River and lower Columbia River basins that is termed the "action area." The action area is defined as "all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action" (50 CFR ə 402.02). A dam and reservoir directly influence three basic areas: the mainstem channel downstream of the structure, the portion of channel and valley that is impounded, and locations upstream that are or could be accessed and used by migrating fish. A dam may also indirectly influence a wider area by facilitating human development and population growth, which ultimately can lead to influences on listed organisms living in nearby river basins that do not have a dam present. For purposes of this consultation, the action area includes explicitly:

1) All mainstem river reaches, riparian zones, and floodplain areas located downstream of Willamette Project facilities, including the Willamette River and its tributaries on which the facilities are located (i.e., mainstems of North Santiam River, South Santiam River, Santiam River, McKenzie River, South Fork McKenzie River, Blue River, Fall Creek, Middle Fork Willamette River, Row River, Coast Fork Willamette River, and the Long Tom River), and the lower Columbia River;

2) Stream reaches and land area permanently or seasonally inundated by Willamette Project reservoirs in dry, average and wet years; and

3) All reaches of tributaries located upstream of Willamette Project facilities that are presently or were historically accessible to listed fish migrating upstream or downstream through 1) and/or 2).

Areas influenced indirectly by the action cannot be identified as clearly because of the complexity of the Willamette Project, and because of the large range in non-Willamette Project activities and environmental conditions occurring within the rest of the Willamette River basin. The large scale, indirect effects of the Willamette Project imply that the action area should effectively include the entire Willamette River basin.

This chapter begins with a general description of specific features of project operations that are common to all thirteen facilities and that directly influence the action area. Each facility is then described individually or in pairs depending on whether one of the two facilities reregulates flows from the other. Specific, federally enacted or sponsored measures designed to provide fish passage, fish protection, project mitigation, and fishery enhancement are identified where appropriate. The purpose of this chapter is to provide a concise and complete picture of the facilities and operations of the Willamette Project that influence listed species.

2.1 GENERAL DESCRIPTION OF PROJECT OPERATIONS

Fern Ridge Dam was constructed as a storage project near Eugene in 1941 as the first element of the Willamette Basin Plan. Since then, twelve additional projects have been constructed. In addition to Fern Ridge, other storage projects include Cottage Grove, Dorena, Detroit, Lookout Point, Hills Creek, Cougar, Green Peter, Fall Creek, and Blue River. Big Cliff and Dexter are reregulation projects that are linked to operation of the Detroit and Lookout Point projects, respectively. Foster serves as both a storage reservoir and as a reregulation facility for Green Peter. The thirteen existing projects are shown in Figure 1-1 and are described in Table 2-1.

The USACE reservoirs in the Willamette River basin contain approximately 1,593,700 acre-feet of useable multiple-use storage (Table 2-1). In general, water is stored and released from mid-April until the end of November in such a manner as to support as many project purposes as possible, including flood control, irrigation, navigation, power generation, recreation, instream flows below projects for aquatic life, wildlife, and municipal and industrial water.

2.1.1 Project Administration

Flow management in the Willamette River basin is the responsibility of the Portland District, USACE. The District's responsibilities include coordination among agencies and interested parties and development of plans for water management within the basin. Consideration of power demands, irrigation demands, minimum stream flow requirements, and other uses of reservoir water must be considered during plan development. Seasonal planning for the spring and summer is based in part on seasonal forecasts by the NRCS.

The RCC is responsible for reservoir regulation and flow management on a daily basis throughout the Columbia River basin, and provides assistance to the Portland District through daily flow and storage regulation in the Willamette River basin. Daily decisions on flow releases are made by RCC based in part on the hydrologic model maintained by the National Weather

Table 2-1. Operational data for Willamette River basin projects.

Project	Minimum Flood Control Pool	Maximum Conservation Pool	Total Conservation Storage	Authorized Minimum Instream Flow Release Feb-Jun	Authorized Minimum Instream Flow Release Jul-Nov	Release Jun	Release Jul and Aug	Drawdown Priority	Flow Augmentation Jul and Aug	Maximum Release for Power
	Feet NGVD	Feet NGVD	Acre-Feet	cfs	cfs	cfs	cfs		cfs	cfs
Hills Creek	1,448.0	1,541.0	194,600	100	100	1,000	300 to 400	4th	kept high for recreation	1,800 (Sep-Oct)
Lookout Point	825.0	926.0	324,200	1,200	1,000	2,500	2,500	1st	2,000 to 2,500 (approx.)	2,500 (Jun-Oct)
Fall Creek	728.0	830.0	108,200	30	30	250	200 to 400	5th	augmt: 200 (Jul); pass fish: 400 (Aug)	na
Cottage Grove	750.0	790.0	28,600	75	50	75	50	5th	reservoir too small	na
Dorena	770.0	832.0	65,000	190	100	250	100	5th	reservoir too small	na
Cougar	1,532.0	1,690.0	143,900	300	200	700	400 to 900	2nd	400 (Jul) and 900-1000 (Aug)	900 –1,000 (Jul-Oct)
Blue River	1,180.0	1,350.0	78,900	50	30	200	50 to 500	3rd	between 50 and 500 (Jul and Aug)	na
Fem Ridge	353.0	373.5	93,900	50	30	50	75	last	kept high for recreation	na
Green Peter	922.0	1,010.0	250,000	300	300	750	650 to 700	5th	as needed for Foster or Salem	up to 4,200 (Sep-Oct)
Foster	613.0	637.0	24,800	600	400	1,250	650 to 700	last	650 to 750	(same as Green Peter)
Detroit	1,450.0	1,563.5	281,600	1,000	750	1,700	900	last	as needed for augmentation	up to 3,000 (Sep-Oct)
Big Cliff										
Dexter										
Total			1,593,700	3,895	2,990	8,725				

Project	PREFERRED RESERVOIR POOL ELEVATIONS
Hills Creek	Reservoir kept high as possible (1,516 preferred) for recreation through Labor Day. Then drafted for flood control.
Lookout Point	Try to be down to elevation 850 by Labor Day, because maximum allowed release of 2,500 in Sep and Oct ("fishing" and spawning).
Fall Creek	Keep pool up until after Labor Day
Cottage Grove	Small reservoir. Held as close to full as possible for recreational use.
Dorena	Small reservoir. Held as close to full as possible for recreational use.
Cougar	No restrictions on pool elevations at this project.
Blue River	No restrictions on pool elevations at this project.
Fem Ridge	Held high for recreational use until Oct 10. Then drafted for flood control by Nov 15.
Green Peter	Held high except for helping Foster to meet minimum releases. Try to keep above elevation 992 until Labor Day.
Foster	For fish passage: Down to 614 through May 20. Re-fill to 637 by Memorial Day from Green Peter and hold through Oct 15.
Detroit	Kept as high as possible around elevation 1,555 through Labor Day for recreation, then drafted for flood control.
Big Cliff	
Dexter	

1. Big Cliff and Dexter are re-regulating dams that have no storage.
2. All projects "originally designed" to begin drawdown after Sep 1 except Fem Ridge (on Sep 20) and Foster (on Sep 30).
3. During a drought, project releases may be cut back to "Minimum Authorized Flows" or below after coordination with state and federal agencies.
4. "Typical Releases: Jul and Aug" shown in column above will vary annually, depending on amounts of precipitation and naturally occurring snowmelt conditions.

Service River Forecast Center. The RCC reviews current reservoir elevations and inflows, the forecast for precipitation, current snow pack conditions, and run-off conditions when making operational decisions. Coordination with the BPA, BOR, and the Portland District is done as needed. The Portland District provides additional coordination when necessary with OWRD, NMFS, USFWS, and others.

The Portland District has a project office located in Lowell, Oregon that handles the daily physical operation of each reservoir in the Willamette River basin, including implementation of daily flow release schedules issued by the RCC. The Lowell, Oregon office also has field personnel located at Lookout Point, Foster, Cougar, Green Peter, Detroit, Fern Ridge, Cottage Grove, and Dorena dams.

2.1.2 USACE Master Planning

The USACE has developed Master Plans for Resource Use at most of the 13 projects in the Willamette Basin. Master Plans are the basic documents guiding USACE responsibilities pursuant to Federal laws to preserve, protect, conserve, restore, maintain, manage, enhance, and develop project lands, waters and associated natural and cultural resources. Master Plans are project-specific comprehensive, project-wide, conceptual guides for the short- and long-term use, management, and development of natural and cultural resources administered by the USACE. Are developed to be consistent and compatible with other regional land use planning and management activities on lands in and adjacent to the USACE projects. Current Master Plans are required for civil works projects undertaken by the USACE, and focus on federal or other fee-owned lands for which the USACE has administrative responsibility. A current approved master plan is necessary before any action can be taken which may restrict the range of future options, and all actions by the USACE and outgrantees must be consistent with the Master Plan.

Master Plans detail project-wide goals, objectives, and organizational frameworks for managing the project, and define how that project can best meet the resource opportunities, needs, and desires of the region. They are broad and conceptual in scope yet identify site specific management units indicating land use classification categories, cultural and resource objectives, and management and development concepts for each. They address regional issues of recreation, economic health and prosperity, and an array of wildlife and fish habitat needs. Master plans cover all resources including, but not limited, to fish and wildlife, vegetation, cultural, aesthetic, recreational, mineral, commercial, and out-granted lands and easements. They identify land use classifications and resource objectives, and prescribe overall land management based on resource use objectives, management units, and associated design and management concepts. They

articulate a desired system for resource management with recommendations for meeting specific environmental goals and objectives.

Master Plans for Resource Use are public documents prepared primarily by interdisciplinary, inter-office study teams and include public involvement and agency coordination. They are developed for use by district staff and field personnel, including interpreters, rangers, biologist, and maintenance staff. Master plans are reviewed and updated regularly (i.e., every 5 to 10 years, or as funds are available) to respond to changes in policy.

The USACE does not initiate construction or implementation of actions based on Master Plans. While information contained within these plans may be useful in preparing NEPA, ESA, or other environmental compliance documents, the Master Plans do not serve to initiate, authorize, nor implement specific construction or other actions by the USACE. ESA consultation and other environmental compliance are undertaken, as applicable, as each specific action is initiated and/or implemented.

Using the Master Plan for Resource Use as a guide, each project's resource and field staff develop and implement individual Operational Management Plans. These are the individual project's plan for implementation of the resource objectives specified in the Master Plan. They contain considerably more detail than a Master Plan, yet are fully compatible with the applicable Master Plan (or detail all deviations and the rationale for them). These short-term plans are annually updated and include an annual work plan. The work plan identifies the priorities, resource requirements, and schedules for the current fiscal years and further in the future.

Master Plans with identified resource use objectives have been developed and approved for the following projects: Foster, Green Peter, Big Cliff, Fall Creek, Dexter, Lookout Point, Dorena, Cottage Grove, and Fern Ridge. The Foster, Big Cliff, Cottage Grove, Dorena, Lookout Point, Dexter, and Fall Creek Master Plans also include current land use plans (i.e., land use classifications in accordance with current regulations).

A master plan has not been developed for Detroit, as all adjacent lands on this project are under the jurisdiction of the Willamette National Forest. The Blue River, Cougar, and Hills Creek projects also do not have current approved Master Plans with resource objectives and land use plans. Project lands at Blue River, Cougar, and Hills Creek are under the jurisdiction of the USFS, Willamette National Forest. However, early planning documents (Design Memoranda) were prepared and provided background information describing terrestrial conditions for plants and wildlife.

Portions of the approved Master Plans and historic Design Memoranda are summarized in the sections below and greater detail, including maps of project lands, are presented in Appendix B. However, the specific project plans should be referenced for further detail.

2.1.3 Project Operations Described by Purpose

The following six subsections describe features of project operations that are common to several or all facilities and that pertain to specific authorized and incidental purposes of the Willamette Project.

2.1.3.1 Flood Control

Flood control is the most important purpose of the Willamette Project. Willamette Project reservoirs are drawn down to minimum flood control pool beginning in September and ending in December according to established operating criteria. Releases are made within the normal operating criteria considering state water management objectives. For instance during the middle of September to the middle of October there is salmon spawning activity downstream of projects such as Cougar, Dexter (Lookout Point), and Big Cliff (Detroit). State water management objectives include attempting to keep flow levels constant and within site specific flow ranges to prevent salmon redds from being dewatered.

The major flood control season occurs between the beginning of December and the end of January after the fall drawdown has been accomplished, although it is not uncommon to experience floods while still in the drawdown mode. During the major flood control season each reservoir is ideally at a minimum flood-control level, or "pool," to store water during flood events for subsequent controlled release. A normal operation during a flood event usually requires quick reductions in project releases, sometimes in a matter of hours, in order to prevent overbank or flooding conditions at control points located immediately downstream of each project and at other locations in the system (Table 2-2). A representative flood control operation is depicted in Figure 2-1. Flood regulation goals for the Middle Fork and mainstem Willamette River are presented in Table 2-3.

Given the rain driven nature of the Willamette River basin and how quickly river levels can rise, timing of such reductions is of crucial importance in reducing the peak flow and flood damages. The large size of the Willamette River basin may influence which projects have their releases controlled when during a flood event, depending on storm track and subbasin-specific antecedent

Table 2-2. Principal downstream flood control points for Willamette River basin projects.

Projects	River	Control Points (River)
Detroit	North Santiam	(North Santiam); Jefferson (Santiam); Salem (mainstem Willamette)
Green Peter	Middle Santiam	Waterloo (South Santiam); Jefferson (Santiam); Salem (mainstem Willamette)
Foster	South Santiam	Waterloo (South Santiam); Jefferson (Santiam); Salem (mainstem Willamette)
Blue River	Blue	Vida (McKenzie); Harrisburg (mainstem Willamette)
Cougar	McKenzie	Vida (McKenzie); Harrisburg (mainstem Willamette)
Fall Creek	Fall Creek	Jasper (Middle Fork Willamette); Harrisburg (mainstem Willamette)
Hills Creek	Middle Fork Willamette	Jasper (Middle Fork Willamette); Harrisburg (mainstem Willamette)
Lookout Point	Middle Fork Willamette	Jasper (Middle Fork Willamette); Harrisburg (mainstem Willamette); Salem (mainstem Willamette)
Dorena	Row	Goshen (Coast Fork Willamette); Harrisburg (mainstem Willamette)
Cottage Grove	Coast Fork Willamette	Goshen (Coast Fork Willamette); Harrisburg (mainstem Willamette)
Fern Ridge	Long Tom	Monroe (Long Tom); Salem (mainstem Willamette)

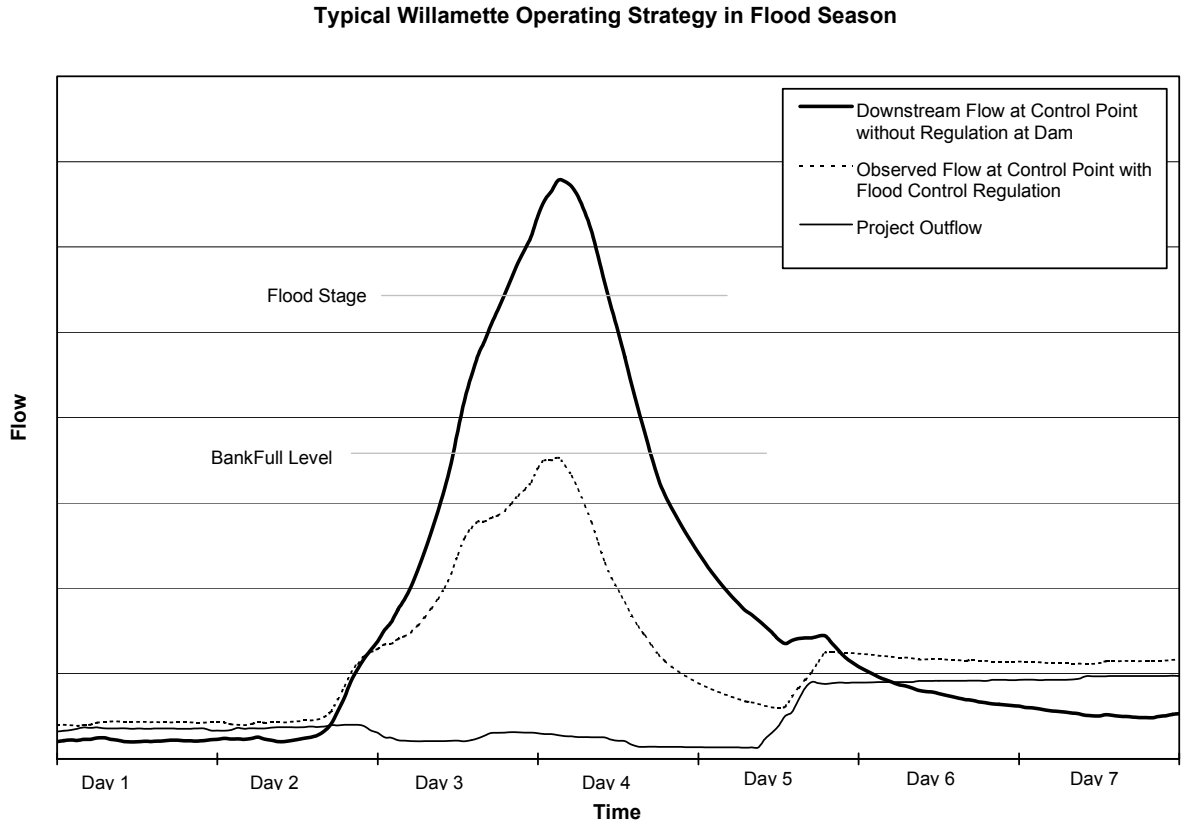

Figure 2-1. Typical flood control operating strategy of Willamette Project facilities.

Table 2-3 Downstream control points on the Middle Fork and mainstem Willamette River.

Gaging Station Name	Identification Number	Willamette River Mile (RM) Distance	Drainage Area (square miles)	Flood Regulation Goals cfs
Middle Fork Willamette River near Jasper, OR	USGS 14152000	RM 195.0	1,340	20,000
Willamette River at Eugene, OR	COE CBT code "EUGO"	RM 182.4	2,030	39,000
Willamette River at Harrisburg, OR	USGS 14166000	RM 161.0	3,420	45,000
Willamette River at Albany, OR	USGS 14174000	RM 119.3	4,840	70,000
Willamette River at Salem, OR	USGS 14191000	RM 84.2	7,280	90,000

conditions, and project-specific features may constrain how each project is operated. Continuous monitoring of hydrometeorological conditions in and near the basin is accomplished with a real-time data collection system. The real-time data are used to prepare flood forecasts and schedule project releases, generally for the next 72 hours in 6-hour increments. Inflows are generally passed through each project until flood forecasts predict that a reduction in outflows is necessary to prevent project releases from combining with uncontrolled local flow from downstream areas to exceed flood regulation goals at the downstream control points. The effect of reductions in releases at one or multiple projects at a control point are a function of travel time and the rate of rise of flood waters. After flows have receded and the danger of flooding has passed, release of stored flood water is coordinated among the projects to prevent overbank conditions downriver, and to return the reservoir to the minimum flood-control pool in anticipation of the next potential flood.

According to established operating criteria, ramping rates for reducing project releases to prevent flooding or increasing flows to evacuate flood water depend on whether there is a high or low flow situation. The type of flow situation depends on factors such as weather, flow forecasts, and flood control storage. During a high flow situation, ramping rates for reducing or increasing releases are more flexible, allowing more rapid changes in order to provide for flood control. During a low flow situation, the ramping rates are more restrictive with respect to hourly and daily changes in order avoid rapid fluctuations in flow levels. If the forecasted flood runoff volume indicates that reservoir space will be exceeded, a special flood regulation schedule is used. This special schedule calls for gradual increases in reservoir releases to avoid sudden increases in outflow as each reservoir fills.

Flood control space in power-producing reservoirs is divided between primary and secondary storage. Primary flood control storage is that space needed to control floods that statistically have a two percent chance of happening in any year (50-year flood). Secondary flood control storage provides additional space to control larger floods that statistically have a one percent chance of occurring (100-year flood). Evacuation of water stored in the primary flood control zone is made through spillway and/or regulating outlets as rapidly after a flood as downstream conditions permit. Water constituting secondary flood control space is generally discharged through the turbines. The ideal power generation situation occurs when it is possible to discharge all of secondary flood control space and reservoir inflows through the turbines. An exception to this is when another flood is imminent, and additional releases must be made through regulating outlets and/or spillways to evacuate more rapidly to minimum flood-control pool. The maximum evacuation releases for normal flood control regulation at each project are listed in Table 2-4.

Table 2-4. Maximum evacuation releases (in cfs) for normal flood control regulation, as measured at downstream control points.

Project	Coast Fork Willamette at Goshen	Middle Fork Willamette at Jasper	McKenzie at Vida	Willamette at Harrisburg	Long Tom at Monroe	Willamette at Albany	North Santiam at Mehama	South Santiam at Waterloo	Santiam at Jefferson	Willamette at Salem
Cottage Grove	3,000			3,000		3,000				3,000
Dorena	5,000			5,000		5,000				5,000
Hills Creek		8,000		8,000		8,000				
Lookout Point		15,000		15,000		15,000				15,000
Fall Creek		4,500		4,500		4,500				4,500
Cougar			6,500	6,500		6,500				6,500
Blue River			3,700	3,700		3,700				3,700
Fern Ridge					3,000	3,000				3,000
Green Peter								11,000	11,000	
Foster								18,000	18,000	18,000
Detroit							17,000		17,000	17,000
Total Evacuation [1]	8,000	19,500	10,200	37,700	3,000	40,700	17,000	18,000	35,000	75,700
Bankfull Flow [2]	12,000	20,000	14,500	42,000	6,000	70,000	17,000	18,000	35,000	90,000
Regulation Goal	12,000	20,000	14,500	42,000	4,650	70,000	17,000	18,000	35,000	90,000

[1] Above control point.

[2] At control point.

Source: Portland District, USACE

Floods are less likely to occur during the period February through early May. This period is referred to as the conservation storage season. Storage space in the reservoirs is filled gradually during this period for later use (irrigation, recreation, power production, water quality, etc.). Each project has a refill rule curve that provides guidance in refilling a project in a controlled manner to desired reservoir elevations for specific dates. Departures from refill rule curves may result from regulation of floods, excessive snow pack above the reservoirs, inadequate water supply, or critical power needs. Excess flood water stored above the rule curve during the conservation storage season is evacuated in accordance with downstream channel capacity. However, maintenance of minimum instream flows downstream of the facility generally takes precedence when the water supply is inadequate to maintain both minimum flows (see Section 2.1.2.5) and the scheduled rate of filling. Deficiencies in storage may be made up at any time beyond early May when the water supply is adequate. Refill of a project can also be delayed when excessive snow pack above the reservoirs causes concern for flooding.

2.1.3.2 Irrigation

Irrigation is practiced throughout the Willamette River basin to provide water for dairy and beef cattle pasture, mint, nurseries, grass, legume seed, fruit, and other produce. Irrigation was recognized as a major purpose in the authorizing project legislation. Collectively, the total joint-use conservation storage at all thirteen projects totals 1.6 million acre-feet. The BOR is responsible for management and development of contracts for use of irrigation water that is stored at USACE projects. On behalf of the federal government, the BOR obtained two water rights certificates (No. 72755 and 72756) from the state of Oregon. These two certificates total 1,640,100 acre-feet of water for irrigation only. These certificates do not accurately represent the true multiple purpose authority of the project, however, and not all of that water has been, or is presently, used. Under federal law, the USACE could still contract for sale of stored water for municipal and industrial water supply or other purposes. However, the fact that all of the stored water in the system is tied up for irrigation under the existing certificates would make it difficult for the users to obtain a state water right permit. This has not been a problem to date because of the low demand for contracts for stored water for purposes other than irrigation (zero to date), but will become one as demands for stored water increase in the future. This issue will be addressed by the WBRS (USACE 1999b). Upon completion of that study, appropriate transfers of use will be filed with the state on the existing certificates, including possible congressional action to allocate reservoir storage to all authorized purposes. The Pacific Northwest River Basins Commission Level B Study recommended about thirty years ago redistributing the allocation of stored water assigned to irrigation to serve other purposes until such time the water was actually needed for irrigation. Also, the 1950 review report on the Willamette River basin

(HD 531) authorized in the Flood Control Act of 1950 that the USACE have discretionary authority to utilize stored water for other purposes, such as recreation, water quality and for fish and wildlife habitat purposes.

Contracts are established between the contractor (user) and the BOR that specify the amount of water that the user may take. Little of the reservoir storage available for irrigation in the Willamette River basin has been contracted (i.e., purchased) for delivery. As shown in Table 2-5, the total storage under contract for irrigation as of May 1999 totaled about 59,911 acre-feet. The largest contract can provide up to 9,625 acre-feet for the irrigation of 3,500 acres. Another six contracts individually serve more than 400 acres and can provide more than 1,000 acre-feet annually. The other 242 contracts currently in effect serve smaller acreages and are almost all with individual water users. The amount of water actually used is less than the amount contracted presently, and is estimated to be less than the 30,025 acre-feet that the BOR billed contractors for in 1999 (BOR data).

Contracts vary in their term from one to forty years. All contracts entered into since 1996, with the exception of eleven proposed temporary contracts for 1999, contain a ten-year term that renews automatically three times. The contract may be terminated unilaterally by either the contractor or the BOR following the first ten-year term or any year thereafter. All contracts are subject to the operating plan of the Willamette Project per laws governing the Willamette Project, and the United States is not liable for shortages.

Since 1994, the ODFW has required applicants for new water right permits to install, operate, and maintain fish screens at diversion intakes and provide for passage past a diversion structure if necessary, unless it has been determined by ODFW that such measures are unnecessary. Older diversions pulling more than 30 cfs are required legally to be screened. Older, smaller diversions are not required to be screened, but ODFW has a cost share program making money available to the diversion owners to install screens. Relatively few of such diversions have been screened through this program to date, however.

There are presently no supplemental USACE releases intended specifically for irrigation use except at Fern Ridge Reservoir, and on very hot days at Detroit Reservoir. Irrigation contracts are generally met within normal dam operations.

The WBRS (USACE 1999b) has estimated future water use. The projected irrigated land area in the year 2020 is approximately 333,000 acres, requiring approximately 811,000 acre-feet from

Table 2-5. Storage volumes presently under contract for irrigation use.

Reach	Reservoir Providing Water	Number of Contractors	Total Acre-Feet Contracted	Total Acres Served
Willamette River				
Downstream of Santiam River	All	38	9,743	6,596
Santiam River–Long Tom River	All except Santiam River basin reservoirs	20	4,718	2,318
Long Tom River–McKenzie River	All except Santiam River basin reservoirs and Fern Ridge	9	1,192	570
McKenzie River–Coast Fork	Fall Creek, Dexter/Lookout Point, Hills Creek, Cottage Grove, Dorena	1	10	4
Middle Fork Willamette River				
Downstream of Fall Creek	Fall Creek, Dexter/Lookout Point, Hills Creek	1	136	54
Fall Creek–Dexter	Dexter/Lookout Point/Hills Creek	3	88	36
Fall Creek	Fall Creek	3	29	12
Coast Fork Willamette River				
Middle Fork – Row River	Dorena, Cottage Grove	12	1,375	568
Row River – Cottage Grove	Cottage Grove	1	56	45
Row River	Dorena	1	51	21
McKenzie River	Blue River, Cougar	37	2,373	1,249
Santiam River to Forks	Detroit/Big Cliff, Green Peter, Foster	7	1,485	1,649
North Santiam River	Detroit/Big Cliff	38	12,343	7,397
South Santiam River	Green Peter, Foster	15	1,134	580
	TOTALS	249	59,911	31,401

Source: BOR data, as of May 1999.

storage. The estimate was based on the assumption that more than 65 percent of the new supplies will come from surface water sources, including primarily Willamette Project storage. The relatively small magnitude of current and projected demands for irrigation water in the Willamette River basin has led to recommendations, including by the Willamette River basin Task Force in the 1960s, to take a portion of active storage presently allocated for irrigation and reallocate it to other uses. Determining future use of storage is a primary purpose of the WBRS.

2.1.3.3 Municipal and Industrial Water Supply

The need for Municipal and Industrial (M&I) storage was found to be relatively low at the time that the storage capacity of the reservoirs was planned. However, the Flood Control Act of 1950 reauthorized the USACE to construct and operate the Willamette Project, as described in HD 531, which included water supply as an intended and authorized project purpose. Because of the potential for a demand in the future, USACE policy makes provisions for reallocating existing storage space and use at a later time if necessary.

2.1.3.4 Navigation

Navigation is an authorized purpose for the upper Willamette River above Willamette Falls. However, navigation has not become as significant of a demand on the water resources as was originally anticipated. The history of authorized navigation dates back to 1871 when Congress authorized the first plan for improving the channel between Portland and Eugene (River and Harbor Act of 1871). The plan was modified several times since, and provided for an 8 foot channel between Portland and Oregon City and a 2.5 to 3.5 foot channel depth between Oregon City and Albany, which were completed in 1939. A 2.5 to 3.5 foot channel depth was completed between Albany and Corvallis in 1945. On the Yamhill River, a dam and lock at river mile 8 provided the 18-mile channel to McMinnville. Due to lack of use by commercial traffic, operation of the Yamhill lock was discontinued in February 1954. The lock and adjacent property were turned over to Yamhill County in 1959 for a park. Uncompleted work on the upper navigation channel consisted of channel improvements and streamflow regulation to control depths of 6 feet at low water from Oregon City to the mouth of the Santiam River and 5 feet from that point to Albany. The USACE maintained the completed portion of the navigation channel to the vicinity of Corvallis until 1973 when commercial navigation traffic declined to a point where the USACE could no longer justify maintaining the project. The portion between Corvallis and Eugene was deauthorized by the Water Resources Development Act of 1986. In the early 1990s, the Mid-Valley Council of Governments investigated the feasibility of deepening the upper Willamette River navigation channel between Newberg and Independence

to facilitate recreational and commercial boat traffic. The study found it was not cost effective to deepen the navigation channel at that time.

An important element of the upper Willamette River navigation project is the Willamette Falls Locks at RM 26 above the confluence of the Columbia and Willamette rivers in West Linn, Clackamas County, Oregon. The canal and locks were first constructed by private interests in 1873. The USACE surveyed the locks and in 1899 government ownership was recommended. The project was authorized by the Rivers and Harbors Act of 1910 (Public Law 61-264) and in 1915, the Federal Government purchased the locks. The existing project consists of four locks each with a vertical lift of about ten feet, a canal basin, and a guard lock used to prevent flooding when river levels are high. From 1987 to 1993, the average annual number of vessels passing through the locks was about 5,700. It is estimated that about 50 percent of the usage of the locks is by commercial barges carrying a variety of products such as gravel, grains, chemicals, timber and lumber. In 1974, the locks were placed on the National Register of Historic Places. In 1991 the locks also were established as an Oregon Civil Engineering Landmark.

The Flood Control Act of 1938 and the Rivers and Harbors Act of 1945 modified the Willamette Falls Locks to allow for construction of a new single lift main lock and a guard lock to replace the existing facilities. This project to build new locks was deauthorized by the Water Resources Development Act of 1986 because navigation did not develop as anticipated.

2.1.3.5 Flow Augmentation

The original authorized plan for the Willamette Project is described in House Document 544, 75th Congress, third session, March 16, 1938. The plan for open-river navigation improvement above Willamette Falls stipulates a minimum flow of 5,000 cfs between Albany and the Santiam River, and 6,500 cfs downstream to Salem to provide navigation depths of 6 feet and 5 feet, respectively. It was also recognized in House Document 544 that these navigation flows would increase flows during the low-water period and would "benefit sanitary conditions along the main stream" by diluting wastes and increase "the dissolved oxygen content of the stream with a resultant beneficial effect on fish life." House Document 531, 81st Congress, second session, March 20, 1950, also stipulates the above minimum flows to allow open-river navigation from Portland to Corvallis. It also recognized that these flows would reduce pollution concentrations in the river, and would make oxygen available for fish life. The water quality and fishery strategies for the Willamette River are currently based on the navigation flow requirements originally established at Albany and Salem.

Albany and Salem remain as summer flow augmentation control points for the Willamette system (June through October). The typical minimum flow requirements at the Albany and Salem control points by time period are listed in Table 2-6. From 1929 through 1988, the water years that were regulated to the drought flow were 1934, 1940, 1941, 1973, and 1977. Table 2-7 lists estimates of the volume of water used from system storage to meet the minimum flow requirements at Albany and Salem during low water and average water years; the volume estimates were modeled based on historic project operations and could change in the future.

Additionally, the RCC and Portland District coordinate an annual summer flow augmentation plan and conduct a coordination meeting with various federal, state, and local agencies to determine instream flows downstream of each project. Agencies include the NMFS, USFWS, OWRD, ODFW, Oregon State Marine Board, and Oregon Department of Environmental Quality (ODEQ). The coordination process attempts to balance the state's water management objectives for the Willamette Project with USACE policy, flexibility, and project authorizations. The OWRD is the lead agency for the state's water management objectives. The objectives are site-specific conditions that drive the state's decision-making process within the existing federal-state coordination framework. Flexibility to manage any one reservoir is influenced both by project authorizations and the USACE's discretionary authority. There are provisions for adjustments to the state's water management objectives for flow conditions in terms of average, better, or below normal water conditions.

Minimum instream flows are also required for fish and other aquatic life below each dam and are higher than historic flows during the summer. These flows serve indirectly as partial mitigation for effects of each dam and reservoir complex on the aquatic ecosystem. Authorized minimum instream flows are listed for each project in Table 2-1.

Water rights issued prior to 1964 are senior to instream flow requirements because that is the year that the State of Oregon first established minimum instream flows for the Willamette River basin. Water rights issued in 1964 and later are junior, and must rely on stored water when natural flows fall below minimum instream flow requirements. Water users with contracts have highest priority during extremely dry years.

Table 2-6. Minimum flow requirements at Albany and Salem (in cfs)

Month	Normal Year at Albany	Drought Year at Albany	Normal Year at Salem	Drought Year at Salem
June	---	4,000	---	5,500
July	4,500	4,000	6,000	5,500
August 1-15	5,000	4,500	6,000	6,000
August 16-31	5,000	4,500	6,500	6,000
September	5,000	5,000	7,000	6,500
October	5,000	---	7,000	---

Table 2-7. Volume of water used to meet minimum flow requirements (acre-feet) at Albany and Salem.

Water Year and Month	Volume from Storage for Albany	Volume from Storage for Salem (includes Albany)
Low Water Year (1973)		
June	0	0
July	83,812	124,368
August	143,325	221,605
Totals	227,136	345,973
Low Water Year (1977)		
June	0	0
July	84,316	135,993
August	134,897	209,625
Totals	219,213	345,619
Average Water Year (1986)		
June	0	0
July	33,383	68,448
August	124,137	169,292
Totals	157,520	237,740

2.1.3.6 Hydroelectric Power Generation

Hydroelectric power facilities are installed at eight of the thirteen USACE projects in the Willamette River basin. The electrical energy generated at these projects is marketed by the BPA throughout the Pacific Northwest and Pacific Southwest. There are two types of federal hydropower projects in the Willamette River basin: storage and reregulation. Lookout Point, Detroit, and Green Peter are storage projects and are associated with reregulation dams located downstream (Dexter, Big Cliff, and Foster, respectively). The Foster project also acts as a storage facility. The Hills Creek and Cougar storage projects do not have reregulation dams located downstream. Power facilities do not exist presently at the Fall Creek, Blue River, Dorena, Cottage Grove, or Fern Ridge projects.

Power generation at the Willamette projects depends typically on releases for other project purposes such as flood control and environmental needs. However, some flexibility exists within the operating criteria to generate electricity at different levels throughout the day and during different seasons. Projects with hydropower facilities include exclusive storage space for power generation but the quantity of storage is relatively small, and drawdowns into power storage are limited to special power requirement periods that may develop during extended cold spells. In general, exclusive power storage is kept full to increase the hydraulic head for power generation. Generation from the storage projects is often based upon daily and weekly fluctuations in power demand ("load") and flows downstream are therefore subject to frequent fluctuations that require reregulation. Power generation at the reregulation projects is more uniform. The reregulation reservoirs are used to absorb the fluctuations in flows from their upstream storage projects and ensure that downstream flows are more uniform for protection of aquatic and human habitat and life.

The average monthly generation in megawatts from 1983 to 1995 is listed in Table 2-8 for each of the Willamette hydropower projects. The larger, high-head projects of Detroit, Green Peter, Lookout Point and Cougar generate considerably more than the lower head, reregulation dams of Big Cliff, Foster, and Dexter. Monthly generation can change drastically from year to year depending on the amount of runoff that occurs in the basin.

Table 2-8. Average monthly power generation (in megawatts), Willamette River basin projects (1983-1995).

Month	Detroit	Big Cliff	Green Peter	Foster	Cougar	Lookout Point	Dexter	Hills Creek	TOTAL
January	51.9	13.9	42.3	15.0	17.0	38.4	10.8	19.2	208.6
February	37.8	10.1	22.0	11.5	11.3	28.2	5.8	12.5	139.1
March	35.5	9.0	20.7	12.2	10.4	27.9	5.5	12.7	134.0
April	35.6	9.9	23.3	12.5	14.5	32.0	6.0	15.5	149.2
May	51.3	12.2	26.5	10.6	19.3	47.1	9.0	21.1	197.2
June	42.4	9.7	17.8	9.0	16.3	40.0	7.3	18.2	160.6
July	25.9	5.5	12.2	5.2	14.0	26.6	5.5	9.6	104.5
August	23.1	4.7	12.7	4.5	22.2	33.4	8.1	9.9	118.8
September	43.3	10.6	22.8	8.8	22.3	36.9	9.6	27.5	181.8
October	56.4	15.5	26.1	12.0	20.6	36.0	9.7	27.0	203.4
November	65.3	17.1	52.0	16.7	18.7	53.4	13.1	26.0	262.3
December	57.9	15.3	54.6	17.7	18.6	46.0	12.2	23.1	245.4
SUM	526.5	133.6	333.0	135.6	205.4	445.8	102.7	222.3	2,104.9

2.1.3.7 Recreation

Recreation use and development is authorized at all the USACE projects under federal legislation, including the Federal Water Projects Recreation Act of 1964 (Public Law 89-72), and the Flood Control Act of 1944. Under these authorities, the USACE is primarily responsible for providing recreation facilities. The USACE cooperates with the USFS, Oregon State Parks, ODFW, and Linn and Lane counties to build and manage a system of water-related recreation facilities. Recreation facilities are provided at all of the USACE's projects and along most of the downstream reaches. Annual visitation to the reservoirs includes 3.6 million recreation visits to USACE-managed areas, in addition to the estimated 700,000 additional visits to USFS, areas managed by the state of Oregon (including Detroit State Park) and county parks located on the reservoirs.

Recreational demand in the basin is putting more pressure on maintaining reservoirs at high levels for the entire recreational season. A drawdown priority for the projects has evolved over time (Table 2-1). Maintenance of high pool elevations in priority recreation reservoirs is an important consideration in operation of the Willamette Project. Those projects with the highest recreation demand are last to be used for meeting flow requirements at Albany and Salem, so

their pool elevations usually are high until early September. On the other hand, those projects with lower recreation demand are used for meeting summer mainstem Willamette flows, and are drawn down earlier. The three most important recreational lakes in the system, Detroit, Fern Ridge and Foster, are last to be evacuated to meet summer flow requirements. Additional, project-specific details on recreation are presented in the WBRS (USACE 1999b).

2.1.4 Fisheries Mitigation

Congress authorized the construction, operation, and maintenance of hatcheries in cooperation with state and federal fisheries agencies to mitigate for fish losses due to construction of dams (HD 544, 75th Congress, 3rd Session, 1938; Public Law 732, 79th Congress, 2nd Session, 1946). Hatcheries and provision of fish passage at selected facilities are the primary forms of mitigation for the Willamette Project and its thirteen dam facilities. Maintenance of instream flows downstream of projects and in the mainstem Willamette River is another form of mitigation.

Significant future improvements are expected to occur as a result of WTC study. The study was in partial response to two Congressional resolutions providing authority for the USACE to evaluate water temperature issues (Senate Committee on Public Works resolution adopted November 15, 1961, for the Willamette River Basin Comprehensive Study; and House Committee on Public Works and Transportation resolution adopted September 8, 1988, for the Willamette River Basin Review Study). The purpose of the WTC study was to evaluate the feasibility of modifying dam facilities to restore downstream water temperatures closer to pre-dam levels. Compared to conditions prior to construction of the dam, downstream temperatures in the respective rivers are generally cooler in the spring and early summer, and generally warmer in the late summer and fall, than historic temperatures. The cooler temperatures influence upstream migration of adult fish and warmer temperatures reduce survival of juveniles by influencing emergence timing. Modification of intake structures will allow selection of water temperature for release from different projects by drawing water from different elevations in each reservoir.

Long-term plans are to modify and operate projects to restore stream temperatures in the South Fork McKenzie River and the North and South Santiam rivers to pre-project levels, and to partially restore pre-project temperatures in the mainstem McKenzie River and Santiam River. Construction activities are presently funded for Cougar only; future funding for the other projects will be partially contingent on the results of the Cougar modifications and on congressional appropriation.

Additional details regarding planned modifications, and projected results, are provided in subsequent sections of this chapter for each project that is part of the WTC study, and later in this BA in the Analysis of Effects (Chapter 6).

2.1.5 System Operation

All USACE Willamette projects are operated together as a system. Seasonal regulation of each reservoir is guided by the flood control rule curves. Rule curves are presented in Appendix C for each project; the plots also include actual reservoir elevations for the period 1990-1999. The function of the rule curve is to show how much storage space a reservoir should reserve for flood control at any given time of the year. There are three defined control periods in a year: flood control, conservation storage, and conservation holding and release. The dates of these seasons vary slightly by project. The RCC is responsible for the daily regulation of all thirteen dams, and for coordination with other federal agencies such as the BPA. During wet winter conditions, when flood control is the primary authorized purpose, coordination with BPA could occur once a week. Coordination at other times could occur several times a day.

Each project is drawn down according to a prioritization system that has been determined according to hydrologic flood control and recreational needs, primarily. Draw-down priorities are presented in Table 2-9. These priorities are balanced against individual project priorities that are also presented in Table 2-9.

The Willamette Project is operated in conjunction with the Columbia River Basin Project to provide power to the Northwest power grid system. Generally, power production in the Willamette River basin is not adjusted directly to compensate for power shortfalls elsewhere within the system, except insofar as individual projects are operated under a load following schedule to meet additional power demands within the Willamette River basin and nearby areas. However, during power emergencies in winter month "cold snaps," BPA can call upon increased releases for generation and use water from the designated power pools as long as it does not negatively affect flood control. Recent changes in operation of the Columbia system in response to the NMFS (1995b) Biological Opinion require reductions in spill to reduce levels of total dissolved gas. As part of this, turbines at Willamette Project facilities are shut down, and water is spilled through regulating outlets and/or over spillways to provide for flows needed in the lower Columbia River.

Table 2-9. Priorities of Willamette River basin storage projects.

Project	Drawdown Priority for Augmenting Summer Stream Flow	Priority Purposes (USACE 1989a)				
		Flood Control[1]	Power Generation	Recreation[2]	Navigation	Irrigation
Detroit	Last	✓	✓	✓	✓	✓
Big Cliff	NA		✓			
Green Peter	5th	✓	✓		✓	✓
Foster	Last	✓	✓	✓	✓	✓
Blue River	3rd	✓			✓	✓
Cougar	2nd	✓	✓		✓	✓
Fall Creek	5th	✓			✓	✓
Hills Creek	4th	✓	✓		✓	✓
Lookout Point	1st	✓	✓		✓	✓
Dexter	NA	✓	✓		✓	✓
Dorena	5th	✓		✓	✓	✓
Cottage Grove	5th	✓		✓		
Fern Ridge	Last	✓		✓	✓	✓

[1] Has highest priority to ensure public safety.

[2] During summer months.

2.1.6 Land Use Management

Within the Willamette Basin, the USACE administers over 30,000 acres of project lands. The Corps of Engineers Regulations 1130-2-435 directs that the land use classifications for project lands be consistent with project land allocations. The term allocation represents the identification and documentation of the specific or generally authorized purposes for which project lands were acquired. USACE lands are further classified based on their highest and best uses. The process of zoning the project area into land use classifications represents a further distribution of management categories which, based on the resource available and public need, will allow for full utilization while protecting project resources. USACE land use classifications define resource management and development practices, which may be either appropriate or inappropriate for that parcel of land. There are five land use categories into which lands at USACE projects may be classified: Project Operations, Recreation, Mitigation, Environmental Sensitive Areas, and Multiple Resource Management. The latter can be further subdivided into Low-Density Recreation Use, General Wildlife Management, Vegetative Management, Inactive and/or Future Recreation Areas, and Easement Lands. The extent of these lands on each of the projects is summarized in Table 2-10.

2.2 DESCRIPTION OF DETROIT AND BIG CLIFF PROJECTS

2.2.1 Project Information

Detroit and Big Cliff dams are located on the North Santiam River about 45 miles southeast of Salem, Oregon. Detroit Dam is a storage project; Big Cliff Dam is located three miles downstream of Detroit Dam and reregulates fluctuating flows released by the latter. Schematic diagrams of the two dams are included in Appendix A. Detroit Dam has been in operation since 1953 and Big Cliff Dam since 1954. The dams control runoff from a 438-square mile drainage area. As of September 1996, total construction costs were $62,729,700, operation and maintenance costs $40,825,300, and rehabilitation costs $363,100, for a total federal cost of $103,555,000.

Detroit Lake is one of the two most popular USACE lakes for recreation (OWRD 1999). The lake has extensive public facilities that are operated by the USFS and Oregon Parks and Recreation Department. The Detroit Lake pool is maintained as high as possible through Labor Day because of the high demand for water-based recreation. Detroit Lake is drafted rarely for flow augmentation on the mainstem Willamette River in the summer. Recreation activity associated at Detroit Lake is a major contributor to the local economy according to the OWRD

Table 2-10. Land use classifications for USACE Willamette Basin project lands.

	Land Use Classification (acres)									
				Multiple Resource Management						
Project	**Project Operations**	**Recreation**	**Environ-mentally Sensitive Areas**	**Recreation (Low Density)**	**Wildlife Mgmt (General)**	**Vegetation Mgmt**	**Future and/or Inactive Recreation**	**Water**	**Easements**	**Total Area**
Detroit and Big Cliff[1]	152				59	170		3,600 136		4,117
Green Peter	1,563	332		100	737			3,605		6,337
Foster	93	120		138	319	214				884
Blue River[2]	245	440						975		1,660
Cougar[2]	50	30		220						300
Fall Creek	78	242		437	1,023			1,757		3,537
Hills Creek[2]	230								14	244
Lookout Point	52	75	424	379		2423	240	4227		7,820
Dexter	52	172			200		20	1025		1,469
Dorena	180	76		83	169	195	6		72	781
Cottage Grove	90	109			133	68			10	410
Fern Ridge	121	299	182	193	2,721		81	8,224	959	12,780
Total	2,906	731	182	193	3,223	263	81	8,224	1,041	40,339

[1] Land Use Allocations recognized prior to current regulations.

[2] No current valid Master Plan and land use allocations.

(1999). The average annual number of recreational visits for Detroit Lake is estimated by OWRD (1999) to be 735,000.

The Detroit power facility is a power peaking ("low load factor") plant with two Francis turbines, each with a capacity of 50,000 kilowatts. The hydraulic capacity of the powerhouse is 5,300 cfs. Peak demand hours are usually in the morning and in late afternoon. Detroit reservoir has exclusive power storage of 40,000 acre-feet that is located between pool elevations 1,425 (minimum power pool) and 1,450 feet. Flows downstream can fluctuate daily between zero and 5,340 cfs daily, and there are no restrictions on ramping rates (USACE 1989a). Power generating head ranges between 219 and 371 feet depending on lake elevation. There are four regulating outlets at Detroit Dam.

The Big Cliff power facility is a base load ("high load factor") plant and is operated as a reregulating project for Detroit. This reregulation operation causes pool elevations behind Big Cliff Dam to fluctuate typically several feet, and as much as 24 feet, daily. Recreation facilities are limited at this project to one unimproved boat ramp because of rapid fluctuations in water level, small size of the impoundment, steep side slopes of the river valley, and generally difficult access. Power is generated by a single Kaplan propeller turbine with a capacity of 18 megawatts. The hydraulic capacity of the powerhouse is 3,100 cfs. The exclusive power pool is 1,800 acre-feet between elevations 1,182 and 1,206 feet. Power generating head ranges between 73 and 98 feet depending on lake elevation. Maximum permitted downramping rate ranges between 200 and 400 cfs/hour during low flow periods, or 30 percent of discharge per half-hour, per agreement between the USACE and fisheries agencies (USACE 1989a). There are no regulating outlets at Big Cliff Dam.

The spillway crest is approximately 53 feet above the tailwater elevation at Big Cliff Dam, which has three spill gates, and 343 feet at Detroit Dam, which has six.

2.2.2 Passage, Protection, Mitigation, and Enhancement Measures for Fish

Spring chinook salmon and winter steelhead trout spawned historically above the location of Detroit Dam. There are no fish passage facilities for adults or juveniles at either Detroit Dam or Big Cliff Dam. Downstream migrant fish would have to pass through the turbines, regulating outlets, or over the spillways.

2.2.2.1 Hatchery Production

The Marion Forks Hatchery and Minto Holding Pond were built by the USACE in 1950 to mitigate for loss of salmon-spawning areas upstream from the project. Both facilities are operated by the ODFW. Adult fish trap and holding ponds are located at the Minto fish collection facility that is located approximately two miles downstream of Big Cliff Dam. The Minto facility includes a constructed weir that prevents fish passage upstream. The weir acts as a velocity barrier. The Minto facility and Marion Forks Hatchery provide mitigation for lost winter steelhead and chinook salmon that inhabited the North Santiam above the projects prior to their construction. There has also been production of summer steelhead at the Marion Forks Hatchery and smolts are released at the Minto facility. Adult summer steelhead trapped at Minto are recycled to the fishery downstream. ODFW has recently discontinued stocking of hatchery winter steelhead smolts in the basin. 1997 and 1998 hatchery production data are presented in Appendix B.

Additionally, per state water management objectives and given consideration in the summer flow augmentation plan, the USACE maintains, when possible, flows between 1,000 and 2,500 cfs from 15 September to 15 October to facilitate good working conditions at the Minto fish collection facility and to provide for chinook salmon spawning activity downstream. Flows in excess of 2,500 cfs may induce chinook salmon to spawn on portions of the channel cross-section that may become dewatered during reservoir refill operations.

2.2.2.2 Water Temperature Control Project

Downstream impacts to water temperatures were not anticipated at the time of construction of Detroit Dam. Prior to project construction, the North Santiam River was cold, where mean daily summer temperatures near Detroit were generally less than 17EC (USACE 1988). Compared to conditions prior to construction of the dam, downstream temperatures in the North Santiam River in the spring and early summer are presently cooler, and temperatures in the late summer and fall warmer, than historically: Detroit Dam discharges water that is 4EC to 9EC cooler in the summer, and 2EC to 5EC degrees warmer in the fall (USACE 1988). The cooler temperatures impact upstream migration of adult fish, and the warmer temperatures reduce survival of juveniles by accelerating emergence timing in the mainstem river, thereby potentially increasing fry exposure to adverse winter environmental conditions. Project temperature and flow effects generally extend to the confluence of the Santiam River with the Willamette, over a distance of approximately 40-60 miles (USACE 1988).

A reconnaissance study was initiated in October 1984 of the flows and temperatures of the Santiam River by the USACE Portland District as part of the Willamette System Temperature Control Study. Plans included improving downstream water temperatures for native fish by modifying the existing intake tower at Detroit Dam and involved construction of a multilevel tower with six ports. Modification of the structure would allow selective water temperature release from the project by drawing water from different elevations in the reservoir. The project would be operated with the objective of restoring water temperatures in the North Santiam River to pre-project levels. Detroit Lake elevations would be altered to be at their maximum in summer, then drawn down in fall in preparation for flood control. Modeling studies suggested that the historic temperature regime could be restored in this manner. Feasibility-level studies have not yet been conducted.

2.2.3 USACE Project Lands

This summary of USACE lands at the Detroit and Big Cliff projects on the North Santiam River is based upon detailed information provided in the following documents: *Master Plan for Resource, Mid-Willamette Valley Projects/Foster - Green Peter - Big Cliff, Part I - Resource Use Objectives* (USACE 1981a); and *Master Plan for Resource, Mid-Willamette Valley Projects/Foster - Green Peter- Big Cliff, Appendix 1 - Technical Data* (USACE 1981b). Maps and further details are provided in Appendix B.

USACE project lands at Detroit Lake are limited to the dam and associated operations facilities; the USACE maintains no project lands other than those that directly support the facilities and operations. Most lands adjacent to Detroit Lake are managed and operated by the USFS, Willamette National Forest. Big Cliff Lake is located in a narrow, rocky gorge. Development is constrained by steep shoreline slopes and absence of places where recreational facilities could be provided. Furthermore, daily fluctuations of water levels in Big Cliff Lake can reach as much as 24 feet. This fluctuation, coupled with the small amount of available land and the relatively small size of the lake (136 acres at maximum conservation pool), limits development potential for recreation. As a consequence of the limited project lands at the Detroit and Big Cliff projects, the USACE does not maintain current master plans, resource objectives, and land use plans for either project.

Big Cliff is the least developed of the 13 Willamette Valley projects, having only an unimproved boat launch ramp. Recreation at Detroit Lake includes two parks operated by the Oregon Parks and Recreation Department. Mongold is a day-use area, while the Detroit Lake State Park has campsites and RV camps. The USFS runs three campgrounds: Piety Boat Camp, Hoover

campground, and South Shore campground. Private moorage facilities are available in the town of Detroit.

An early master plan for the Big Cliff, Foster, and Green Peter projects (USACE 1981a, 1981b) identified land use allocation classifications for 517 acres of project lands at Detroit and Big Cliff. These include project operations (152 acres), reserve forest land (170 acres), and wildlife management (59 acres). The remaining land is open water (136 acres) at Big Cliff. The USACE project lands are also divided into 5 discrete geographic areas. Resource objectives were identified that are specific to each of the 5 areas, and reflect the recognized land use allocation. This information is detailed in Appendix B.

The only listed, proposed, and candidate threatened or endangered wildlife and plant species and species of concern documented at or in close proximity to Big Cliff and Detroit Lakes is bald eagle (*Haliaeetus leucocephalus*). Northern spotted owl (*Strix occidentalis*) and Canada lynx (*Lynx canadensis*) may occur in the broader resource area surrounding these projects.

2.3 DESCRIPTION OF GREEN PETER AND FOSTER PROJECTS

2.3.1 Project Information

The Green Peter Dam is located on the Middle Santiam River about 30 miles southeast of Albany in Linn County, Oregon. The Foster project is located about 8 miles downstream of Green Peter on the South Santiam River. The Middle Santiam River empties into the Foster impoundment. Foster Dam reregulates hydropower releases from Green Peter Dam. Schematic diagrams of the two dams are presented in Appendix A. Both dams have been in operation since 1968 and control runoff from a 227-square mile drainage area. As of September 1996, total construction costs were $84,005,800 and operation and maintenance costs $41,293,700, for a total federal cost of $125,299,500.

In addition to power peaking, Green Peter Dam is also operated to ensure sufficient storage in Foster Lake to maintain steady flows downstream because of fishery needs and other outflow requirements, including augmenting flows at Salem during low flow years. The Green Peter power facility consists of a peaking plant with two Francis turbine units, each with 40 megawatt capacity. The maximum hydraulic capacity of the powerhouse is 4,600 cfs, while the minimum is 700 cfs. Green Peter has exclusive power storage of 63,000 acre-feet between elevations 887 and 922 feet. Although the minimum power pool is at elevation 887 feet, the units can no longer generate when the pool elevation drops below 900 feet. Under most conditions, all outflow from Green Peter is passed through the power plant. Flows downstream can vary between zero and

4,420 cfs daily, and there are no restrictions on ramping rate (USACE 1989a). Power generating head ranges between approximately 187 and 323 feet depending on lake elevation. Green Peter Dam has two regulating outlets.

The Foster Dam power facility consists of two Kaplan turbines, each with 10 megawatt capacity. The hydraulic capacity of the powerhouse is between 1,600 and 3,600 cfs. Outflows above the maximum turbine capacity are released over the spillway and are generally limited to the 18,000 cfs downstream channel capacity. The minimum power pool is at elevation 609 feet. Power generating head ranges between approximately 85 and 115 feet depending on lake elevation. Maximum allowable downramping rate is 30 percent of discharge per half-hour, per agreement between the USACE and fisheries agencies (USACE 1989a). There are no regulating outlets at Foster Dam.

Foster Lake is the most popular water-oriented recreation resource in Linn County. Its recreation facilities are operated primarily by the County. Foster Lake is drafted rarely for flow augmentation of the mainstem Willamette River because of its high priority for recreation. The average annual number of recreational visits for Green Peter and Foster Lakes are estimated by OWRD (1999) to be 230,000 and 590,000, respectively. Flows downstream of Foster Dam are maintained between roughly 750 and 800 cfs during June and July to provide water for boaters in the river.

The spillway crest is approximately 72 feet above the tailwater elevation at Foster Dam, which has four spill gates, and 269 feet at Green Peter Dam, which has two.

2.3.2 Passage, Protection, Mitigation, and Enhancement Measures for Fish

Spring chinook salmon and winter steelhead trout spawned historically above both dam sites. There are fish passage facilities at both projects, although their operations have had mixed results. Fish passage facilities at Green Peter Dam have been mothballed since 1988 because of passage and survival problems described below. Hatchery production was initiated as mitigation for lost habitat in the reservoir areas. Other mitigation activities included stocking lakes with resident fish.

In average flow years, the USACE maintains flows of approximately 1,500 cfs in September and October below Foster Dam to provide for chinook salmon spawning activity below the project, and to prevent redd dewatering during refill operations.

2.3.2.1 Upstream-Migrant Passage Facilities at Foster Dam

A fish ladder and elevators at Foster Dam are used to trap adult salmon and steelhead that are then transported to the South Santiam Fish Hatchery. Non-native summer steelhead are returned downstream to the sport fishery, while native winter steelhead are transported upstream for release in the South Santiam above Foster Dam. Fish passing upstream at Foster Dam enter either the tailrace or spillway ladder entrance and then pass up a short ladder section to the trapping area. Trapping and transport equipment for adult fish ascending the ladder includes a holding pool, a fish-crowder, an anesthetic tank, and a crane and hopper facility for lifting the trapped adults up to the top of the dam where they can be loaded into a truck for release upstream of the reservoir or placed into the dam forebay.

The holding pool is located at the head of the fish ladder and has a finger weir at the downstream end allowing entry and preventing escape. Fish are crowded into an anesthetic tank by a "fish-sweep." Anaesthetized fish are counted and examined for marks, tags, injuries, and occasionally other information. Excess anadromous and other fish species are returned downstream. Desirable species are placed in the 1,000 gallon fish-hopper for transport over the dam. The fish-hopper is operated by a craneway-hoist facility that is located on top of the dam and facilitates emptying the hopper into either the dam forebay or a transportation truck.

The water source for the Foster Dam adult collection facilities originates in the upstream end of the number 1 penstock. Two intakes are located at different elevations for mixing and establishing a suitable water temperature in the fish ladder. However, the upper intake, which is 38 feet deep at full conservation pool, is located too deep to increase the ladder water temperature in the spring and summer. Water entering the intakes is routed through two distribution systems. The first supplies water to the holding pool from where it passes down the fish ladder. The second system provides supplemental attraction flow at the spillway entrance to the ladder. The spillway entrance is a 4-foot wide weir orifice gate that is controlled automatically to provide suitable entrance velocities. Flows from the spillway entrance are usually a constant 100 cfs. Up to four pumps can be placed on line to provide auxiliary water to the tailrace entrance. Attraction flow at the tailrace entrance may vary from 41-160 cfs depending upon tailrace water levels. Fish enter the ladder from the tailrace either through a 6-foot wide weir-orifice gate or an 18-inch wide free flow slot. The weir orifice gate at the tailrace is controlled similarly to the spillway entrance gate.

The main fish ladder was constructed with a 1 on 10 slope and consists of 8-foot wide by 6-foot high overflow weirs that are located 10 feet apart. Each weir has an 18-inch square submerged

orifice located at the bottom center. A one-foot water surface elevation drop is maintained between pools at a 37 cfs flow rate. A four foot wide transportation channel connects the spillway entrance with the tailrace entrance pool and is designed to maintain velocities of 1-2 fps throughout its length.

There is also a trapping facility located on the right bank below Foster Dam that consists of a short, small gradient fish ladder leading to a trapping pool. Trapped fish are either taken upstream and released in the South Santiam River, returned downstream, or transported to the South Santiam Fish Hatchery. Few fish are kept in the trapping pool during the warmer summer months because of disease problems related to water temperature and close confinement. Most adults are allowed to hold in the dam tailrace instead until it is decided that they are ready to move upstream.

The upstream passage facility experiences fallback problems when winter steelhead and spring chinook salmon are placed in the forebay because they may return down to the tailrace via the turbines and possibly through the spillway downstream migrant surface collector (Buchanan et al. 1993). Adult salmon and steelhead are likely to experience mortality when as they fall back through the penstock entrance and pass through the turbines, and thus adults are generally released upstream of the reservoir instead.

2.3.2.2 Upstream-Migrant Passage Facilities at Green Peter Dam

Trap and transport equipment for adult fish ascending the Green Peter fish ladder are similar to those described for Foster Dam. Two major differences are incorporated into the Green Peter facilities. The first of these is in the Green Peter holding pool. Instead of a fish-sweep, there is a brail located on the floor that is raised to crowd the fish into the fish-hopper, and no provisions were made for anesthetizing, handling, or sorting fish. The second modification is the placement of two fish-hoppers on a turntable just upstream from the holding pool. This dual system allows one hopper to be in position to trap fish while the other is being lifted over the dam.

Adult upstream migrants were reluctant to enter the fish collection system because of the low temperature of attraction water. Collection efficiency was low as a result. The water supply for operation of the Green Peter fish ladder facility originates in a penstock entrance similar to Foster Dam, but is drawn from a much greater depth at approximately 165 feet below the reservoir surface. The attraction water was consequently much colder than in-river. Adults were attracted to water coming through the juvenile passage facility instead, which drew warmer water from the reservoir surface. The penstock water passes through a 1,000 kilowatt fish-water

turbine and energy dissipator before entering the fish ladder. A standby system may also pass water directly from the penstock to the energy dissipator and into the fish ladder. Auxiliary attraction water was added by pumps at the fishway entrance when the power units were operating. The pumps added up to 110 cfs, making a total attraction water discharge of 160 cfs at the fishway entrance. The fish ladder weirs and slope are similar to that at Foster Dam. The ladder entrance from the tailrace is through either a 3-foot-wide weir-orifice gate or through an 18-inch wide free flow slot. Before the collection system was shut down, operation of the entrance gates and auxiliary attraction flow was similar to that at Foster Dam.

2.3.2.3 Downstream-Migrant Passage Facilities at Foster Dam

Collection or transport facilities were not provided initially for downstream migrant juvenile salmonids at Foster Dam. Instead, the Kaplan turbines were designed to pass them. The centerline of the penstock entrance is at elevation 590, between 23 and 50 feet from the surface depending on reservoir level. This location was incorporated into the design of the dam to gain maximum attraction (commensurate with powerhouse operation) of juvenile salmon moving through the reservoir. The Kaplan turbines were designed to pass smolts with an 8 percent mortality rate (Buchanan et al. 1993) and are operated primarily at 88 percent efficiency or above 800 cfs discharge during the fall, winter, and spring, where high efficiency is generally associated with maximum survival of downstream migrants (Wagner and Ingram 1973).

Downstream migrants also exit from Foster Reservoir through the spillway gates during spill periods. A flow of approximately 300 cfs is passed over the spillway to facilitate passage. Flows through the spillway depend on releases needed to maintain desired pool elevations. The elevation drop is accordingly approximately 75 to 90 feet. A weir positioned at the surface of the forebay was designed to pass downstream migrant winter steelhead moving near the water surface. The forebay is maintained at a reduced elevation (614 NGVD) during the period of April 15 to May 20 to facilitate use of this design. Steelhead kelts also probably take advantage of this mode of downstream passage. This operation is part of the state's water management objectives, and the RCC accommodates the request within USACE policy and project authorizations.

2.3.2.4 Downstream-Migrant Passage Facilities at Green Peter Dam

The presently mothballed Green Peter downstream migrant collection and passage facility is located near the spillway. Major components of the system include a collection horn, attraction water pumps, a screened fish separator unit, and a transport-pipe system extending down the

downstream face of the dam. The horn is 20 feet high by 6 feet wide and is adjustable in depth (as measured from the centerline of the horn to the pool surface) between 15 and 30 feet. This allows sampling of pool elevations ranging between 1,015 (maximum pool) and 922 (minimum conservation pool) feet.

Flow through the system was provided by two 100-horsepower pumps that draw water from the bottom of a well facility and discharge it back into the forebay. With both pumps in operation, a differential of approximately 3.5 to 4 feet was maintained between water in the forebay and that in the well. This differential caused water to flow into the horn, through a vaned conduit, and across the separator unit. Fish passing through the horn entered with an approach velocity of 0.1 foot per second 18 feet from the horn. The velocity increased to about 10.0 fps at the throat of the horn and across the separator screen. All but approximately 6 to 10 cfs of the attraction water flowed through the screen. The fish entered a trough at the end of the separator leading to a 12-inch flexible hose that is attached to one of four 12-inch lateral conduits passing through the dam, and were moved down the downstream dam face through a 24-inch stainless steel transport pipe. The flexible hose is made of reinforced rubber and has a smooth interior surface to prevent abrasion of fish. The flexible hose connects to one of the four laterals depending on forebay elevation. The lateral conduits are black iron pipe that have been coated with vinyl to prevent rusting and provide a smooth transportation surface. At the downstream end of the powerhouse, the stainless steel transport pipe changes to a vinyl-lined iron pipe that extends 300 feet downstream and provides a deceleration zone before entering a rubber-lined chute that empties into the tailrace. Fish experienced abrasion problems for a few years when the stainless steel pipe corroded, but the problem was fixed (Wagner and Ingram 1973).

The downstream passage facility was mothballed in 1988 primarily because of predation problems. The young fish had to negotiate a large reservoir with irregular shoreline and little to no attraction flow toward the dam. The reservoir possesses extensive habitat for illegally introduced smallmouth and largemouth bass, resident northern pikeminnows, and other species. Passage efficiency of migrant juvenile salmonids through the lake was approximately eighty percent in the early years after dam construction, but gradually dropped to near zero as predator populations grew in the reservoir and there were not enough fish to sustain runs of either spring chinook or winter steelhead (Buchanan et al. 1993; USACE 1995b). The numbers of returning adult spring chinook rearing in the reservoir dropped considerably by the early 1980s, to the point that, for the years 1980-1982, the average adult return was 194 fish. Winter steelhead numbers also began to decline substantially in the early 1970s.

A reconnaissance report (USACE 1995b) investigating restoring native winter steelhead trout and spring chinook salmon runs in the South Santiam River subbasin determined that the fish passage facilities originally constructed at the Green Peter project do not provide effective juvenile and adult passage for anadromous fish to access their natural spawning and rearing habitat upstream from the project. The report determined that a collection system at head of the reservoir is needed so that steelhead/salmon can be trucked or piped around the reservoir and dam in order to avoid reservoir related mortality. It recommended the use of floating juvenile surface collectors in the upper arms of the reservoir (Quartzville Creek and the Middle Santiam River) and correcting the water temperature in the adult fish ladder as the most cost-effective means.

The Office of the Assistant Secretary of the Army for Civil Works concurred that the project's existing fish passage facilities have not functioned as intended and that modifications are needed to meet the project's authorized mitigation requirements. Remedial actions are to be pursued under the USACE O&M authority as a major rehabilitation project. The USACE has proposed constructing a prototype model surface collection system near the points of entry of Quartzville or the Middle Santiam River in Green Peter Reservoir and transport of steelhead/salmonids around the reservoir and dam. If funding were to be secured, the USACE would design and install a prototype surface collection system and initiate collection and transport around the reservoir and dam of steelhead/salmonids. The effectiveness of the system would be monitored, evaluated, and modified if necessary. The feasibility of installation at the other USACE dam projects in the Upper Willamette ESU would be evaluated should the prototype prove to be successful.

2.3.2.5 Hatchery Production

The ODFW South Santiam River Fish Hatchery was relocated and expanded to provide mitigation for loss of spawning grounds and rearing areas when the projects were completed in 1968. Capacity of the Leaburg Hatchery was also increased to provide additional resident salmonids for stocking in the reservoirs. The USACE pays approximately seventy percent of the total hatchery operation and maintenance costs.

2.3.2.6 Water Temperature Control Project

Downstream impacts to temperatures were not anticipated at the time of construction of Green Peter Dam and Foster Dam. Compared to conditions prior to construction of the two dams, downstream temperatures in the Middle and South Santiam rivers in the spring and early summer

are presently cooler, and temperatures in the late summer and fall warmer, than historically. Green Peter Dam discharges water that is up to 11EC to 15EC cooler in the summer, and 1EC to 2EC warmer in the fall. Foster Dam discharges water that is up to 7EC to 11EC cooler in the summer and 2EC to 3EC cooler in the fall (USACE 1988). The cooler temperatures impact upstream migration of adult fish, and the warmer temperatures reduce survival of juveniles by accelerating emergence timing in the mainstem river, thereby potentially increasing fry exposure to adverse winter environmental conditions. Project temperature and flow effects generally extend to the confluence of the Santiam River with the Willamette, over a distance of approximately 40-60 miles (USACE 1988).

A study was initiated in October 1984 of the flows and temperatures of the Santiam River by the USACE Portland District as part of the Willamette System Temperature Control Study. Plans are presently unclear regarding specific modifications to be made at either Green Peter Dam or Foster Dam because of physical complications peculiar to each project and their locations relative to one another. Continuation of the project is pending the results of modifications to Cougar and Blue River dams first, and is subject to funding availability. Foster Lake receives water from both the Middle and South Santiam rivers, making it more difficult to control temperatures, and the South Santiam River basin as a whole was warmer historically than the North Santiam. Modifications to either facility would likely still result in cooler water in the summer (by about 3EC) and warmer water in the fall (by about 2EC) than historically (USACE 1988). Structural modifications would allow selective water temperature release from either project by drawing water from different elevations in the reservoir. The goal would be to operate the projects in such a way that water temperatures in the Middle and South Santiam rivers could be restored to pre-project levels as much as possible.

2.3.3 USACE Project Lands

Neither the Green Peter nor Foster projects have current, valid Master Plans and current land use plans. However, early resource objectives were identified for each. This general overview of project lands for Green Peter and Foster Lakes on the Middle and South Santiam Rivers is based upon detailed information provided in the following documents: *Master Plan for Resource, Mid-Willamette Valley Projects/Foster - Green Peter - Big Cliff, Part I - Resource Use Objectives* (USACE 1981a); *Master Plan for Resource, Mid-Willamette Valley Projects/Foster - Green Peter- Big Cliff, Appendix 1 - Technical Data* (USACE 1981b); *Master Plan for Resource, Mid-Willamette Valley Projects/Green Peter Lake, Part II Plan of Development* (USACE 1987); and *Foster Lake Master Plan Design Memorandum No. 14* (USACE 1976). Maps and further details are provided in Appendix B.

At maximum conservation pool, the irregularly shaped Foster Lake covers approximately 1,195 acres. About 916 acres of project lands are located above the pool, with 165 of these used for managed recreational areas. The remaining 751 acres are used for general project access, easements, other allocations, and project operations functions. The Foster Lake project lands are divided into 13 individual parcels (sites). At Foster Lake, the identified project-wide objective is to "retain and enhance the recreation values of the project while protecting and preserving the projects natural characteristics.

Green Peter Lake is three times as large as Foster Lake, with approximately 3,605 acres of water surface. About 2,700 acres of project land is located above the maximum conservation pool level, but only 332 of these are used for recreation. The remaining project lands are steep, narrow strips that have value as buffer areas and wildlife habitat. The project lands at Green Peter Lake are delineated into 18 management units.

Opportunities for fishing, boating, water skiing, camping, and picnicking are available at Green Peter and Foster Lakes, with approximately 1,166,400 recreation visits made in 1996. Recreation at Green Peter Lake includes Whitcomb Creek Park and Thistle Creek boat ramp. These are administered by Linn County Parks and Recreation Commission. Public recreation at Foster Lake includes Sunnyside Park, Lewis Creek Park, and Gedney Creek Boat Ramp. These are also administered by the Linn County Parks and Recreation Commission. Andrew S. Wiley Park and Shea Point are Foster Lake parks operated by the USACE.

Five basic vegetative cover types are identified at the projects. These are open natural area, disturbed area, deciduous forest, mixed deciduous/coniferous forest, second growth coniferous forest, and old growth forest. The majority of the coniferous forest of the area is second growth Douglas fir with western hemlock. Logging is the principle industry of the area and old-growth timber areas are rare. The dominant tree in the deciduous forest is red alder. Wetlands and shallow-water ponds are a limited resource at the projects. Due to the topography of the lakes, there are only three wetland areas in the projects, all within Foster Lake. Each of these sites is in disturbed areas, and although these areas are small, they do provide the necessary habitat for a large group of water and marsh birds. These wetlands and shallow water ponds are located at Lewis Creek and the old fish hatchery site. Other important habitats at Foster Lake identified as warranting special wildlife management consideration include mineral springs in the Foster Dam Quarry site (potentially important for band-tailed pigeons); mature timber and snags at Neuhaus Point, the South Santiam arm to Menear Bend, and at the Middle Santiam from the Old Fish Hatchery Park to the project boundary receive heavy use by osprey and great blue herons; and

timbered area north and south of Bufford Road on Neuhaus Peninsula serves as winter range for deer. The use of Foster Lake project lands by many wildlife species, and the potential for intensive and extensive wildlife management activities is constrained by existing recreational development, urban contact, a small land base, steep terrain, roads along the edge of the reservoir, and large water level fluctuations. However, neighboring lands, particularly those under the jurisdiction of the BLM, have high wildlife values.

At Green Peter, existing recreational development and a small land base generally limit the potential for intensive wildlife management activities. However, several sites have been identified as possessing capability to support limited wildlife management programs. The upper arm of the Middle Santiam River provides range for deer and elk. Other limited opportunities exist to sustain and possibly improve existing habitats and minimal wildlife populations by exercising wildlife management practices in association with other resource uses and management actions. Important habitats identified at Green Peter Lake as warranting special wildlife management consideration include project lands north and south of Green Peter Dam (band-tailed pigeons, grouse, quail, and deer); Tally Creek Park (band-tailed pigeon and elk); drawdown areas on the north and south sides of the Middle Santiam arm of the project (winter range for elk); mature timber and snags in the Middle Santiam arm (osprey and bald eagle); and mature timber and snags at Whitcomb Creek Park (pileated woodpecker).

Listed and proposed threatened or endangered wildlife and plant species documented at Foster Lake include bald eagle and northern spotted owl. Canada lynx is thought to occur in the broader resource area surrounding Foster Lake. Species of concern and candidate species documented at Foster Lake include northwestern pond turtle (*Clemmys marmorata marmorata*), tall bugbane (*Cimicifuga elata*), and Howell's montia (*Montia howellii*). The foothills yellow-legged frog (*Rana boylii*), another species of concern has been extirpated from Foster Lake.

Listed and proposed threatened or endangered wildlife and plant species documented at Green Peter Lake include bald eagle and northern spotted owl. Canada lynx is thought to occur in the broader resource area surrounding Green Peter Lake. Species of concern or candidate species documented at Green Peter include the northern red-legged frog (*Rana aurora aurora*) and northwestern pond turtle.

2.4 DESCRIPTION OF BLUE RIVER PROJECT

2.4.1 Project Information

Blue River Dam is located on the Blue River, a tributary of the McKenzie River about 40 miles east of Eugene, Oregon. The dam has been in operation since 1969 and controls runoff from a 88-square mile drainage area. As of September 1996, construction costs totaled $32,038,200 and operation and maintenance costs $3,951,100, for a total federal cost of $35,989,300. Blue River Dam is also operated in conjunction with Cougar Lake to control the McKenzie River and Willamette River. Water can be released from Blue River Lake during the summer months to augment flows on the mainstem Willamette River. Augmentation is generally not needed from Blue River in average or above average years and the project either passes inflow or maintains minimum instream flows. The average annual number of recreational visits for Blue River Lake is estimated by OWRD (1999) to be 66,000. The project's recreation facilities, all within the Willamette National Forest, are operated by the USFS.

There are no hydroelectric facilities presently. The Eugene Water and Electric Board (EWEB) was granted a 50-year license by the Federal Energy Regulatory Commission (FERC) to generate power at the Blue River Dam in 1989 and plans to install a single turbine with a capacity of 21 megawatts. The project is presently on stay until 2005 at the earliest, pending the outcome of the WTC study. The project will involve modification of existing ACOE facilities and building additional facilities to route water currently released from the existing regulating tunnel outlet to the proposed power house. Modifications include lining existing outlet tunnel with steel liner to accommodate increased pressure and construction of regulating outlet gates to divert water to a penstock. A fish screen and bypass system was proposed under the original license to protect downstream migrating fish from passing through the powerhouse and bypass them back to the Blue River; however, a settlement agreement between EWEB, NMFS, USFWS, and ODFW was approved by FERC that amended the license and involved establishment of a $2,200,000 trust fund for salmon enhancement instead. A concrete weir fish barrier is proposed for construction to restrict fish from swimming upstream and route them to a planned adult trap (EWEB 1999).

The spillway crest is approximately 230 feet above the tailwater elevation at Blue River Dam, with two spill gates.

2.4.2 Fish Passage, Protection, Mitigation, and Enhancement Measures

There are no fish passage facilities for either adult or juvenile fish at Blue River Dam. The McKenzie Hatchery was constructed to mitigate for spring chinook salmon losses caused by the Blue River and Cougar dams. Return data for 1997/1998 for the McKenzie Hatchery are presented in Appendix B.

2.4.2.1 Water Temperature Control Project

There is a congressionally authorized plan to improve downstream water temperatures for native fish by modifying the existing intake tower. Downstream impacts to temperatures were not anticipated at the time of construction of Blue River Dam. Compared to conditions prior to construction of the dam, downstream temperatures in the McKenzie River in the spring and early summer are cooler while temperatures in the late summer and fall are warmer. The cooler temperatures impact upstream migration of adult fish and warmer temperatures reduce survival of juveniles by impacting emergence timing. Modification of the intake structure will allow selection of water temperature for release from the project by drawing water from different elevations in the reservoir. The project will be operated to restore stream temperatures in the Blue River to pre-project levels and to partially restore pre-project temperatures in the mainstem McKenzie River.

Construction of the proposed Temperature Control Project would involve drawing down Blue River Reservoir during the summer low flow period and construction of a diversion dam. A diversion conduit will pass 800 cfs at 16 feet of head. A residual pool would also be maintained upstream of the diversion structure to trap sediment and provide aquatic habitat; the pool would be approximately 40 surface acres, 40 feet deep, and store approximately 1000 acre-feet of water. Construction would be halted and the reservoir returned to its flood control function until the diversion was able to safely maintain the pool elevation below the level of construction. Construction activities are tentatively scheduled to begin in 2005 and finish in 2006, but are contingent on Congressional appropriation.

A selective withdrawal system would be added directly to the intake tower and positioned upstream over the regulating outlet works. Water would be withdrawn from specific elevations in the reservoir using seven ports. All ports would be throttled with slide gates to control outflow temperatures. Each port would have the capacity when fully open to pass 500 cfs with velocities under 10 fps. Additional details are provided in USACE (1995).

2.4.3 USACE Project Lands

This summary of USACE project lands at the Blue River project is based upon information provided in an early *Blue River Lake Master Plan* (USACE 1974a). Maps and further details are provided in Appendix B. The Blue River project is located within the Blue River District of the Willamette National Forest. At full pool, the lake's surface area is 940 acres. Except for minor private holdings, USFS land surrounds the entire project. A Memorandum of Understanding (MOU) between the USFS and the USACE set forth divisions of land and water jurisdiction and management responsibilities. This division of management responsibilities dictated the scope the early *Blue River Lake Master Plan* (USACE 1974a). This plan was limited to providing background resource information for the USFS to assist in coordinating planning of future uses of the Blue River Lake area.

The USACE has jurisdictional responsibilities for management of lands and waters required for operation, maintenance, and protection of project works. In addition, the USACE regulates the reservoir in accordance with authorized project purposes. The USACE operates a visitor's viewpoint on the north side of the main dam. Facilities include a parking lot and a small viewing structure. Most areas with recreational and land use impact are under the jurisdiction of the USFS. The USFS is responsible for development and management activities not directly associated with operation and maintenance of the dam and reservoir facilities. Their responsibilities include the development and management of public recreation areas adjacent to the reservoir, recreational use of the lake, collection and disposal of debris from the water surface, and management of the resources on the lands adjacent to and surrounding the project. Overnight camping is available at Mona Campground and boat launch facilities are provided at Lookout Creek ramp. Fishing, swimming, and water skiing are also available at the two recreation areas, both near the upper end of the lake.

At Blue River Lake there are two project operational areas, the main dam and the auxiliary dam. The former is a gravel-filled embankment dam with an impervious core. An intake structure, regulating outlet, and spillway section are located near the south abutment. A public parking area and viewpoint are situated at the north abutment. The structure of the auxiliary dam is similar to that of the main dam except that the auxiliary dam does not have release and regulation facilities. The east abutment is presently used for a boat ramp and parking area.

Blue River Lake lies at mid-altitudes on the west slope of the Cascade Range. It controls runoff from a watershed area of 88 square miles that is characterized by steep forested slopes, narrow small creeks, and diverse forest types. Steep slopes and relatively little flat land area adjacent to

the pool severely limit the public use potential of the lake. The pool is generally at maximum conservation pool from early in May until mid-July. Throughout the autumn, the pool elevation is continually lowered to reach a minimum level by 15 November. The drawdown of the pool exposes extensive raw cut banks, denuded rock areas, and mud flats.

The mountainous region surrounding Blue River Lake has a wide diversity of vegetation but in general, the dominant tree species are Douglas fir and western hemlock. Red alder and bigleaf maple occupy several moist sites and riparian habitats. This region is rich in songbirds, and supports mammals such as black-tailed deer, Roosevelt elk, black bear, mountain lion, chipmunks, and Douglas squirrel. Ten distinct ecosystem patterns in the lake area were recognized in the early Master Plan. These were natural openings, wetlands, riparian forests, lowland moist forests, moist forests, dry forests, successional forests, restocked clearcuts, clearcuts, and disturbed areas. The Master Plan also identifies the following land use categories the Blue River Lake project: Project Operations, Intensive Use Recreation, Low Density Use Recreation, Natural Areas, Reserve Forest Lands. For lands under the jurisdiction of the USFS, the indicated designations are suggested land use potentials only. Each of these ecosystem patterns and land use categories are detailed in Appendix B.

The bald eagle is the only listed threatened or endangered wildlife or plant species documented at Blue River Lake. The northern spotted owl, Canada lynx, and other listed, proposed, candidate, and species of concern may occur in the broader resource area surrounding Blue River Lake.

2.5 DESCRIPTION OF COUGAR PROJECT

2.5.1 Project Information

Cougar Dam is located on the South Fork McKenzie River, about 42 miles east of Eugene, Oregon. The dam has been in operation since 1963 and controls runoff from a 208-square mile drainage area. A schematic diagram of Cougar Dam is included in Appendix A. As of September 1996, total construction costs were $58,63,400 and operation and maintenance costs $19,651,400, for a total federal cost of $78,287,800. Water is released from Cougar Lake during the summer months to augment flow in the mainstem Willamette River for fish and water quality. The average annual number of recreational visits for Cougar Lake is estimated by OWRD (1999) to be 64,000.

The Cougar power project consists of a base load plant of two Francis turbines each with a capacity of 12.5 megawatts. The maximum hydraulic capacity of the powerhouse is 1,050 cfs. Cougar has exclusive power storage of 9,900 acre-feet between pool elevations 1,516 and 1,532 feet. Flows downstream can vary between 100 and 1050 cfs daily, but are usually constant because of base load operation. There is no restriction on downramping rate, which is normally 500 cfs per hour during high flow periods and 200 cfs per hour during low flow periods (USACE 1989a). Power generating head ranges between approximately 263 and 449 feet depending on lake elevation. There is one regulating outlet with two gates. The spillway crest is approximately 452 feet above the tailwater elevation at Cougar Dam, with two spill gates.

A power project called Strube Lake was authorized by the Flood Control Act of 1962 to be located on the South Fork McKenzie River below Cougar Dam and serve as a re-regulation facility. However, no funds have been expended on the project for a number of years and there are no plans to do so in the future. The project has been deauthorized.

2.5.2 Passage, Protection, Mitigation, and Enhancement Measures for Fish

Spring chinook salmon historically spawned upstream of the Cougar Dam location, and bull trout were present in the past and continue to be present. There is natural production currently of spring chinook salmon above Cougar dam in the South Fork McKenzie from adults that were introduced by ODFW, beginning in 1993. The salmon are being used to provide nutrients to the system by means of their carcasses, and eggs and progeny for bull trout consumption. Goals also included starting a landlocked salmon fishery in the reservoir (ODFW 1999c).

Releases in the fall are usually around 700 cfs to facilitate spring chinook spawning downstream. Flows are managed to prevent subsequent redd dewatering. Minimum outflows in the spring are 300 cfs, ensuring refill in the spring. This operation is part of the state's water management objectives and the RCC accommodates the request within USACE policy and project authorizations.

2.5.2.1 Fish Passage Facilities

Adult and juvenile passage facilities were designed and constructed as part of the Cougar Dam facility. The design included trapping of adult salmon below the powerhouse at a collection facility in the tailrace channel, and transportation by truck for release near the head of the reservoir. Juvenile downstream passage is provided in the permanent construction of the intake structure. An evaluation of the fish passage facilities found that entry of adult chinook into the

South Fork McKenzie River was unsatisfactory, and an adult trap downstream did not function properly. Collection and survival of the juveniles passing the dam was also unsatisfactory despite good rearing conditions in the reservoir. With the failure of the fish passage facilities, the Oregon Fish Commission recommended that mitigation be accomplished by hatchery rearing instead (Ingram and Korn 1968).

Adult collection facilities were located in the tailrace channel 200 yards downstream from the powerhouse on the east bank. A rack in the tailrace channel diverted fish into a trap with two chambers. Entry was provided over a finger weir or through a submerged orifice into the first chamber. A hopper was submerged in the second for collecting, counting and hauling the fish. The hopper was lifted and transferred to a flatbed truck for hauling upstream to the release site. Few fish were collected by this facility in 1965 and 1966, however, and a temporary trap was constructed in the regulating outlet channel that consisted of a two-step ladder leading to a removable hopper; the hopper from the permanent trap was used, and the fish were hauled as before. Tests showed that adults were collected best in reservoir surface water discharges through the regulating outlet (Ingram and Korn 1968).

There are five fish horns incorporated into the intake tower for collecting downstream migrants. The horns are 20 feet high by 9 feet wide at the opening and are spaced vertically 39.5 feet apart to provide an outlet relatively near the water surface over a range of reservoir elevations. Maximum design flow rate into a horn is 350 cfs with 50 feet of head. Flow into each horn is controlled by a butterfly valve and an emergency gate valve. Fish enter the horn, which narrows to a 3 foot diameter pipe, pass the two valves into a well 5 feet in diameter, and drop vertically to the regulating outlet at the bottom of the intake tower. The fish exit the outlet down a chute into a stilling basin that leads to the regulating outlet channel. Problems were evident with the system with respect to collection efficiency during the spring, when water surface elevations were 10 to 45 feet above the horn, and to fish injury as they passed through the dam facility (Ingram and Korn 1968).

2.5.2.2 Hatcheries

The USACE built the McKenzie Fish Hatchery near Leaburg on the McKenzie River as mitigation for loss of fish habitat caused by construction of the Cougar and Blue River projects. The hatchery was authorized specifically by Congress (HD 531, 81st Congress, 2nd session, 1950). ODFW operates the hatchery. The USACE pays fifty percent of the operation and maintenance costs.

2.5.2.3 Water Temperature Control Project

There is an authorized plan to improve downstream water temperatures for native fish by modifying the existing intake tower. Downstream impacts to temperatures were not anticipated at the time of construction of Cougar Dam. Compared to conditions prior to construction of the dam, downstream temperatures in the McKenzie River in the spring and early summer are cooler while temperatures in the late summer and fall are warmer. The cooler temperatures impact upstream migration of adult fish and warmer temperatures reduce survival of juveniles by impacting emergence timing. Modification of the intake structure will allow selection of water temperature for release from the project by drawing water from different elevations in the reservoir. The project will be operated to restore stream temperatures in the South Fork McKenzie River to pre-project levels and to partially restore pre-project temperatures in the mainstem McKenzie River. Cougar Dam modifications will be the pilot project for the remainder of Willamette Temperature Control Project. Resulting costs and benefits will be evaluated before other projects are modified.

Construction of the proposed Temperature Control Project is scheduled to begin this year and involves drawing down Cougar Reservoir to near stream level for four successive construction seasons until the project is completed in 2003. The diversion tunnel used in the original construction of Cougar Dam will be reopened to draw the lake down. The diversion will pass up to 2,000 cfs. A minimum residual pool will also be maintained upstream of the diversion structure at elevation 1375 to trap sediment and provide aquatic habitat; the pool will be approximately 106 surface acres and store approximately 2,845 acre-feet of water (Design Memorandum #28, July 1998). Large storm events exceeding the diversion capacity and associated storage will be controlled with the regulating outlet.

A new, ported, multi-level intake tower will be constructed. A selective withdrawal system (SWS) will be added directly to the intake tower and positioned upstream over the regulating outlet works. Water will be withdrawn from specific elevations in the reservoir using eight ports. All ports will be throttled with slide gates to control outflow temperatures. Each port will have the capacity when fully open to pass 1,000 cfs with velocities under 10 fps. A penstock bypass port will be located upstream of the existing penstock entrance to bypass the SWS as needed. Additional details are provided in USACE (1995) and Design Memorandum #28, July 1998.

This BA addresses long-term effects expected after construction is completed. Activities related specifically to construction are being assessed under a different consultation, and are described in a separate BA (USACE 1999a).

2.5.3 USACE Project Lands

The Cougar Lake project does not have a current Master Plan with identified resource objectives and land use plan. Most land surrounding Cougar Lake is under the jurisdiction of the Willamette National Forest. In 1974, the USACE developed a guide for the orderly and coordinated development and management of land and water areas in and adjacent to the project. That early *Cougar Lake Master Plan* (USACE 1974b) and accompanying *Recreation-Resource Management Appendices* (USACE 1974c) are briefly summarized below. Further information and maps are provided in Appendix B.

A MOA between the Department of Army and the Department of Agriculture was signed in 1964. A project MOU was also signed between the USACE and the USFS that sets forth divisions of land jurisdiction and management responsibilities. Essentially, the USACE is responsible for the lands occupied by the lake, the dam, and related structures. Most areas with recreational and land use impact are under the jurisdiction of the USFS, who is responsible for the development and management of activities not directly associated with the operation and maintenance of the dam. They are responsible for recreational activities adjacent to the reservoir, recreational use of the lake, and management of the resources on the lands adjacent to and surrounding the project. The primary responsibility for the protection, preservation, and enhancement of wildlife habitat at Cougar Lake is with the Blue River Ranger District of the Willamette National Forest, which administers most of the land adjacent to the lake. The USACE involvement in wildlife management consists of habitat enhancement and protection on USACE administered lands at Cougar Lake.

Existing public use facilities at Cougar Lake include Delta Campground, which occupies 17 acres between the McKenzie River and the South Fork Willamette River. Additional recreational facilities include the Echo picnic area and boat ramp and Slide Creek Campground. USACE project land at Cougar Lake occupies 50 acres in two areas that include the dam embankment area and land acquired for road relocation.

Construction of Cougar Dam and access roads has resulted in a huge cut into bedrock on the east wall of the valley and a variety of smaller disturbances that sharply contrast the natural condition of the surrounding lands. The upper end of the lake is exposed during the winter drawdown

period. Wave action, fluctuating pool levels, and steep banks affect the shoreline of Cougar Lake. This combination of conditions precludes significant vegetation establishment on the banks of the lake.

Five major wildlife habitats are recognized at Cougar Lake. These include coniferous forest, brush tree, natural and artificial openings, and streams. The mountainous region surrounding Cougar Lake has a wide diversity of vegetation, but in general, the dominant tree species are Douglas fir and western hemlock, with an understory that varies with microclimate. Ten distinct ecosystem patterns in the lake area have also been identified. These are natural openings, wetlands, riparian forests, lowland moist forests, moist forests, dry forests, successional forests, restocked clearcuts, clearcuts, and disturbed areas.

The 1974 Design Memorandum identifies that the objectives for vegetation and wildlife management at Cougar Lake are to increase the value of reservoir lands for aesthetical, recreational, and wildlife purposes, and to promote natural ecological conditions by following accepted conservation practices. In managing the vegetation, primary consideration is to be given to wildlife habitat with additional consideration given to aesthetical and recreation benefits. Appendix B provides further detail.

Cougar Lake and adjacent habitats are known to support bald eagles and northern spotted owls, and may support Canada lynx. Harlequin duck (*Histrionicus histrionicus*) have been observed in the tailrace of Cougar Dam.

2.6 DESCRIPTION OF FALL CREEK PROJECT

2.6.1 Project Information

Fall Creek Dam is located on Fall Creek, a tributary of the Middle Fork Willamette River about 20 miles southeast of Eugene, Oregon. The dam has been in operation since 1966 and controls runoff from a 184-square mile drainage area. A schematic diagram of the dam is included in Appendix A. As of September 1996, total construction costs were $22,118,300 and operation and maintenance costs $8,760,400, for a total federal cost of $30,878,700. The lake has a low drawdown priority for augmenting stream flows on the mainstem Willamette River in the summer, reflecting its relatively high priority presently for recreation. The average annual number of recreational visits for Fall Creek Lake is estimated by OWRD (1999) to be 269,000.

Fall Creek currently does not possess hydropower facilities. There is one regulating outlet with two gates. An interim feasibility study was conducted for adding power generation to Fall Creek

and was approved by the USACE in July 1984. The recommended plan was for the construction of two turbine/generating units, with installed capacity of 9.8 megawatts, but existing operations of Fall Creek would not change. The plan was not implemented however and there are no plans to install power generation in the foreseeable future. Four FERC permits have been filed in the past to install power generation facilities at Fall Creek Dam but none are valid currently.

The spillway crest is approximately 133 feet above the tailwater elevation at Fall Creek Dam. The spillway has two spill gates but has never been operated. There is a beaver pond located below the spillway in the channel that has a reintroduced population of Oregon chub.

2.6.2 Passage, Protection, Mitigation, and Enhancement Measures for Fish

Operation goals include a minimum release flow of 150 cfs between April and June and limiting maximum flows of 1000 cfs from September to October, per ODFW request and as part of the state's water management objectives. The RCC attempts to accommodate the request within USACE policy and project authorizations. In below-average water years, the USACE and ODFW have coordinated a compromised release schedule with a few days of minimum flow releases and a few days of 150 cfs released alternately throughout the summer to conserve water while also providing the ODFW flow request.

2.6.2.1 Upstream-Migrant Passage Facilities

Salmon and steelhead enter a short fishway at the base of the dam, either through a raceway at the downstream end or through one of two submerged orifices that open into a secondary stilling basin. The fish follow a series of pools up into a holding pool at the head of the fishway. A steel finger weir prevents them from dropping back out of the holding pool. The fishway operator uses a power sweep to crowd fish in the holding pool into a tank for subsequent anesthetizing. The operator then transfers the anesthetized adults into a 1,000 gallon-capacity liberation truck, releases other game species and rough fish back into the tailrace. The operator then trucks adult salmon and steelhead to a liberation area located approximately two miles upstream of the full reservoir at a site on the North Shore Road that is called Site "C".

2.6.2.2 Downstream-Migrant Passage Facilities

Downstream passage facilities consist of fish horns arranged in groups of three, each at the 800-, 765-, and 720-foot elevations on the face of the dam, to collect emigrating salmon and steelhead smolts. Each tier contains a large, intermediate, and small fish horn. Three individual conduits

serve to pass emigrants from the horns through the dam and discharge them into the fishway approach channel. The three large horns are connected to a 36" diameter pipe conduit, the intermediate horns to a 24" pipe, and the small horns to an 18" pipe. The volume of attraction flow into the transport system can be varied by operating any of the three sets of horns, according to size and elevation. The operator can manipulate temperature of the discharge when the reservoir is stratified thermally by opening horns in the tier nearest the desired thermal stratum, provided that the water temperatures in the reservoir are known at each level.

The head of water over the horns determines the volume of discharge from the emigrant-transport system. At full pool, maximum discharge cannot exceed about 280 cfs. Ball valves, located at the base of each horn adjacent to the transport conduit, regulate flow into the fish horns. Gate valves, located in the downstream segments of the individual transport pipes, are used in instances of emergency.

The facility was designed where downstream migrants enter the open horns, pass through the ball valves into the respective transport conduits that originate at the top of the dam in a venting chamber, and are transported down the face of the dam on the reservoir side. The transport pipes turn downstream under the dam near the intake structure. At this point, the 30" and 24" pipes constrict to 24" and 18", respectively. Immediately downstream of the dam, the transport pipes expand and rise abruptly into a deceleration unit, from which water and fish discharge at a reduced velocity onto a set of perforated plates known as a separator unit. At the separator, most of the water falls through the perforations into a supply pool that subsequently provides attraction water for the upstream-migrant facility. A small amount of water, along with the downstream migrants, passes off the end of the perforated plating into a concrete conduit. This channel leads to the fishway approach channel and the stream below.

The fish horn system proved to be ineffective and smolts were instead passed downstream through 1977 by draining the reservoir in the fall. After 1977 the reservoir was kept up through Labor Day for recreation and the smolts exited through the regulating outlets under high head and high flow conditions. The reservoir rearing program was a success for a number of years following project construction, producing returns of fish in excess of the original run. However, returns after 1977 continued to decline. ODFW assessed the cause of the decline and determined that reservoir operations should be returned to a modified version of the pre-1977 conditions to reduce the high mortality associated with passing the fish through the regulating outlet at high head and flow (Downey and Smith 1992).

The modified drawdown procedure began in 1992 and continued until 1998. The reservoir was drawn down beginning in July from elevation 830 ft at full pool to elevation 824 ft by 15 August and 815 ft by Labor Day. Discharges were raised after Labor Day to 1200 cfs to bring the lake down below the minimum flood control pool elevation (710 ft) by 15 October. Discharges were lowered at this point to bring the pool to elevation 694 ft by the end of October. Operations guidelines included that the system be shut down when the forebay elevation comes within 20 feet of the center line of the fish horn inlets. The procedure was halted when rearing of fingerlings in the reservoir was abandoned in favor of releasing 100,000 marked smolts below the dam. The horn system is presently operated only to provide supplemental water to the adult collection facility.

2.6.3 USACE Project Lands

This summary of USACE lands at the Fall Creek Lake project is based upon the *Fall Creek Lake Plan of Management and Development* (USACE 1994) (Master Plan). Maps and further details are provided in Appendix B. Project lands at Fall Creek Lake total 3,537 acres (including both fee, public domain, and flowage easements lands), which were acquired for project operational requirements, including lands needed for the dam site, lake area, construction areas, road and utility relocation, and support facilities and structures. No separable lands have been acquired at Fall Creek Lake for any other purposes, including fish and wildlife, recreation, or other purposes. The USACE has 17 outgrants located throughout the project. Two of these are park and recreation leases to Lane County Parks and Recreation Department. One park and recreation lease is to Lane County School District 52 for SKY Camp, an outdoor youth education and recreation facility. The 14 remaining outgrants are primarily for road and utility rights-of-way. No lands at Fall Creek Lake are presently outgranted to other federal, state, or local entities for management of fish, wildlife, or other purposes.

There are seven designated public recreation sites at Fall Creek Lake. Day-use recreation facilities for boating, water skiing, fishing, swimming, and picnicking are provided at Winberry Creek Park and North Shore Park, which are managed by Lane County Parks and Recreation Department. Swimming, boating, and camping are available at Cascara Campground and Fishermans' Point Campground, operated by the USACE. In addition, there are several small, minimally developed day-use areas (Lakeside 1 and 2 and Free Meadow) are also managed by the USACE. Jointly, these parks provide 104 picnic sites, 61 camp sites, nine boat launching lanes, 246 car parking spaces, 192 car/boat trailer parking spaces, two bath houses, one lodge, and six group cabins. Approximately 249,000 recreation visits were made to Fall Creek project areas in 1996.

Coniferous forests are the predominant vegetative community on project lands surrounding Fall Creek Lake. A unique stand of first-growth Douglas fir is found just below the Falls Creek Dam. The Oregon Natural Heritage Program (ONHP) identifies this area as representative of a rare ecosystem. Deciduous forest types are found in all riparian areas, particularly where streams enter the lake, and are also present along parts of the northern shoreline of Big Fall Creek arm. The dominant species of the deciduous forests are black cottonwood, red alder, and bigleaf maple.

Steep shorelines preclude the growth of emergent vegetation along much of the shoreline. However, wetlands persist as fringe marshes of reed canarygrass are located at the upper end of the Winberry Creek Arm where a shallow flat exists between the creek channel and the shoreline. Reed canarygrass is found in small patches and narrow strips elsewhere on the lake, including within Cascara Campground and the upstream area across from Peninsula Road. In addition, a 0.5-acre beaver pond is found in the Douglas fir stand within the Tufti Wildlife Area Unit downstream of Fall Creek Dam.

Grasslands comprised by a mix of native and non-native species. A sizable area is situated below the dam and another grassland area is found on the north shore of the lake. Two additional sites are at Sky Camp, located on the south shore of the Fall Creek Arm, and at Cascara Campground, located at the upstream end of the Fall Creek Arm. These grasslands are mowed in areas developed for public use. Upland grass-forb-shrub communities are present only below the dam. They include non-native grasses, teasel, bull and field thistle, and Queen Anne's lace. Himalayan blackberry has invaded the fields. Areas cleared for roads, dam construction, and the construction of recreation facilities comprise the bulk of the disturbed areas. Much of the vegetation of this disturbed area has regenerated over time.

The Master Plan identifies 12 lake-wide Resource Objectives that reflect the capabilities and constraints of Fall Creek Lake's resources and specify how they should be managed to help fill current and projected public needs and desires. These objectives are detailed in Appendix B, and address project operations, boating, camping, day-use recreation, sensitive, special emphasis, and threatened and endangered plant and animal species, fisheries, wildlife, cultural resources, land use and open space, interpretation, hiking trails, and coniferous forest. The Master Plan also identifies the land use classification for 3,537 acres of project lands. These classifications include project operations (78 acres), recreation (242 acres), low-density recreation (437 acres), wildlife management (1,024 acres), and water (1,757 acres), (and flowage easements (8 acres). The USACE project lands at the Fall Creek Lake Project are also divided into 10 management

units, each described with regard to location, access, existing site uses, adjacent land uses, vegetation, wildlife, cultural resources, and limitations and hazards. Objectives and specific management and development concepts are identified for each management. These are included in Appendix B.

The bald eagles have been observed at Fall Creek but no nest sites have been identified. A northern spotted owl activity center has been identified near Fall Creek Lake. One nest site has been located within one mile of Cascara Campground, with the home range of the pair including the campground and upper tip of the Fall Creek arm of the lake. Other spotted owls activity centers occur on adjacent forest lands. Canada lynx may occur in the general vicinity of the Fall Creek project. Adult northwestern pond turtles, a species of concern, have been observed in the Fall Creek and Winberry Arms of the lake, and in the Tufti Wildlife Area Management Unit, downstream of the Fall Creek Dam. Other species of concern documented at the Fall Creek project include the northern red-legged frog, long-legged myotis (*Myotis volans*), long-eared myotis (*Myotis evotis*), fringed myotis (*Myotis thysanodes*), and Townsend's big-eared bat (*Corynorynus townsendii*). Howell's montia (*Montia howellii*) is the only plant species of concern or candidate plant documented at the Fall Creek project.

2.7 DESCRIPTION OF HILLS CREEK PROJECT

2.7.1 Project Information

The Hills Creek project is located on the Middle Fork Willamette River about 45 miles southeast of Eugene in Lane County, Oregon. The dam was completed in 1961 and was authorized by Document: Flood Control Act of 1950, HR 5742, 81st Congress, 2nd Session, Public Law 516. May 17, 1950. Hills Creek Dam is operated in conjunction with the Lookout Point project located further downstream to meet instream flow needs on the mainstem Willamette River during the summer. It is drafted later than Lookout Point, however, to preserve its pool elevation for boating activities. Hills Creek Dam controls runoff from a 390 square mile drainage area. A schematic diagram of the Hills Creek project is included in Appendix A. The USFS operates the recreation facilities at Hills Creek Dam because the project lies within the Willamette National Forest. The average annual number of recreational visits for Hills Creek Lake is estimated by OWRD (1999) to be 109,000.

The Hills Creek power facility has two Francis turbines each with a capacity of 15,000 kilowatts. The turbines operate at 277 rpm. The hydraulic capacity of the powerhouse is 1,800 cfs. Its exclusive power storage is 49,000 acre-feet between pool elevations 1,414 and 1,448 feet. Power

generating head ranges between 187 and 320 feet depending on lake elevation. There is one regulating outlet with two gates. Hills Creek is often drafted below its flood control rule curve in September and October, with releases up to 1,800 cfs over each entire month in order to maximize power generation in those periods and reduce spill in November.

Flows downstream can vary between 300 and 1500 cfs daily depending on seasonal conditions, although the facility is operated primarily as a base load project with relatively steady flows. Since there is no downstream reregulation dam, peaking with Hills Creek is limited by the need to protect the public from dangerous surges in river elevations, although this influences primarily flow rate increases. Maximum permissible downramping rate is greater, at 4,000 cfs per half-hour (USACE 1989a).

A 100 cfs minimum flow must be maintained during summer low flow periods. However, this is less than the minimum discharge required for efficient operation of the power units (300 cfs) and no power is generated if flow drops below 300 cfs. Water is released during those periods through the regulating outlet.

The spillway crest is approximately 275 feet above the tailwater elevation at Hills Creek Dam but is used rarely.

2.7.2 Passage, Protection, Mitigation, and Enhancement Measures for Fish

There are no upstream or downstream fish passage facilities at Hills Creek Dam. Stocking of the reservoir and the tributary streams with game fish is performed by ODFW. The State-owned Leaburg Fish Hatchery facility was expanded by the USACE as mitigation for losses incurred by the construction of the Dexter, Lookout Point, and Hills Creek projects. The Willamette Salmon Hatchery, located about 1 mile above the mouth of Salmon Creek near Oakridge, is also operated in the context of mitigation. The egg-collection station located below Dexter Dam is operated by ODFW as a satellite facility of Willamette Hatchery.

A reconnaissance study was completed recently that evaluated the feasibility of constructing temperature control facilities at Hills Creek Dam (USACE 1997).

2.7.3 USACE Project Lands

The Hills Creek Lake project lies wholly within the Willamette National Forest and includes both Department of the Army and National Forest land withdrawn for project purposes. In 1963

a joint Master Plan for Reservoir Management and Public Use Development (USACE and USFS 1963) was developed as guide for the orderly and progressive development and administration of the land and water areas of the project. It outlined a plan of development for public use areas and set up policies for management to fit the particular needs of the locality.

The USACE has jurisdictional responsibilities for management of lands and waters required for operation, maintenance, and protection of project works. In addition, the USACE regulates the reservoir in accordance with authorized project purposes. The USACE's dam administration area includes the lands in the immediate vicinity of the dam that are required by the USACE for project operation and maintenance.

The USFS is responsible for the administration of project lands and waters in the reservoir area upstream of the trash boom, including the determination of land use classifications, development, operation, and maintenance of recreation facilities, fire protection, and the authorization of use and occupancy of others. Responsibilities include the development and management activities not directly associated with operation and maintenance of the dam and reservoir facilities, including public recreation areas adjacent to the reservoir, recreational use of the lake, and management of the resources on the lands adjacent to and surrounding the project.

Recreational facilities at Hills Creek Lake area managed by the USFS. Opportunities for picnicking and other recreational activities are provided at Cline-Clark picnic ground, B.T. Beach picnic ground, Bingham boat ramp, Sand Prairie Campground, and Packard Creek Campground. In addition to their regular campsites, Sand Prairie and Packard Creek also have RV camps without utilities. Packard Creek also offers a swimming beach.

The 1963 Master Plan does not identify land use classifications, management units, or other land use categories. Appendix B provides a map illustrating the facilities and land ownership at Hills Creek Lake as they existed in 1962.

The bald eagle is the only listed threatened or endangered wildlife or plant species documented at Hills Creek Lake. The northern spotted owl, Canada lynx, and other listed, proposed, candidate, and species of concern may occur in the broader resource area surrounding the project.

2.8 DESCRIPTION OF LOOKOUT POINT AND DEXTER PROJECTS

2.8.1 Project Information

Lookout Point and Dexter dams are located on the Middle Fork Willamette River about 22 miles southeast of Eugene, Oregon. Lookout Point Dam is a storage project; Dexter Dam is located 2.8 miles downstream of Lookout Point Dam and reregulates releases from the latter. Schematic diagrams of the dams are included in Appendix A. The dams have been in operation since 1954. The dams control runoff from a 1,000-square mile drainage area. As of September 1996, the total construction costs of the two dams were $88,238,400 and operation and maintenance costs $71,647,600, for a total federal cost of $159,886,000.

The average annual number of recreational visits for Lookout Point and Dexter Lakes are estimated by OWRD (1999) to be 97,000 and 321,000, respectively.

The Lookout Point power facility has three Francis turbines each with a capacity of 40 megawatts. The hydraulic capacity of the powerhouse is 9,300 cfs. Lookout Point has exclusive power storage of 12,300 acre-feet between pool elevations 819 and 825 feet. Lookout Point operates as a power peaking facility within the federal Columbia River power system. All outflow from Lookout Point is through the power plant under most conditions. Discharge into Dexter Reservoir can vary between zero and 8,100 cfs daily, and there are no restrictions on downramping rate (USACE 1989a). Power generating head ranges between approximately 95 and 204 feet depending on lake elevation. There are four regulating outlets at Lookout Point Dam.

The Dexter reregulating project is located 3.1 miles downstream from Lookout Point and serves as a base load facility. Power is generated by a single Kaplan turbine with a capacity of 15 megawatts. Maximum permissible downramping rate ranges between 700 and 5000 cfs per hour during high flow periods, and between 300 and 700 cfs per hour during low flow periods; maximum rate of fall n tailwater surface elevation during low flow periods is 0.3 feet per hour and 0.5 feet per day (USACE 1989a). Outflows from Dexter are generally held relatively steady, however. Power generating head ranges between 56 and 63 feet depending on lake elevation. There are no regulating outlets at Dexter Dam.

Lookout Point has a large storage capacity and is drafted first for meeting flow requirements on the mainstem Willamette River in the summer. Minimum flow requirements must be met downstream of Dexter Dam to protect fish and other aquatic life. From February 1 to June 30 generally, a minimum flow of 1,200 cfs is maintained from Dexter. At this minimum flow level,

generation from Dexter is between 4,200 and 4,700 kilowatts depending on pool elevation. From July 1 to November 15, a 1,000 cfs minimum flow is met, which is the minimum generation capacity of the Dexter power unit. In below average years, a minimum flow of 1,000 cfs during the refill period (Feb – Jun) has been coordinated in the past with ODFW and OWRD to help ensure refill. From June through August, a constant flow between 2,000 and 2,500 cfs is attempted to be maintained for angler safety. This operation is part of the state's water management objectives and the RCC accommodates the request within USACE policy and project authorizations. At this outflow the Dexter power unit generates between 10 and 11 megawatts.

The spillway crest is approximately 24 feet above the tailwater elevation and has seven spill gates at Dexter Dam, and 200 feet with five gates at Lookout Point Dam.

2.8.2 Passage, Protection, Mitigation, and Enhancement Measures for Fish

There are no downstream migrant passage facilities at either Lookout Point or Dexter. All fish must pass through the turbines or over the spillways. There is no upstream passage facility at Lookout Point.

There is an adult trapping facility at the Dexter project that is a satellite facility of the Willamette Hatchery, which was built as mitigation for lost production above USACE dams and is located on the Middle Fork Willamette River above Lookout Point Dam near the town of Oakridge. Stock for the Willamette Hatchery also comes from the collection facility at Foster Dam on the South Santiam River (USACE 1997). The facility is operated by ODFW and funded by the USACE (83.75%). There are four raceways (150'x18') that accommodate spring chinook and summer steelhead. Flow rates are approximately 8 cfs in each raceway. There is also an asphalt pond (200'x70') for rearing spring chinook with a flow of approximately 50 cfs during normal operation. All raceways, pond and fish ladder are gravity fed from Dexter reservoir. The fish ladder entrance is located at the base of Dexter Dam on the right bank. The ladder is activated in early June, closed down for a period in late July and opened again for approximately a week in early September to take eggs from late run fish. The upper ladder exits into a holding pond that can accommodate up to 2,000 adults. Fish are removed from the holding pond 2 to 3 times per week. A portion of early run excess chinook hatchery fish are turned over to tribes. Adult fish are also taken to Willamette Hatchery where they are held until they are ready for spawning.

Eggs are incubated at the Willamette Hatchery and fish are reared for approximately 14 months there. The juveniles are transported by truck back to the Dexter facility for release into the rearing pond and raceways. Chinook are released volitionally into the Middle Fork

Willamette from the ponds in Feb/March and also in November. Summer steelhead juveniles are released in April in the Middle Fork Willamette, 1.2 to 1.4 million chinook are produced each year. Approximately 205,000 juveniles are taken to the McKenzie Hatchery for release in the McKenzie River. More than 7000 adult chinook and about 400 summer steelhead have been trapped annually the last two years.

2.8.3 USACE Project Lands

This summary of USACE project lands at the Lookout Point and Dexter project is based upon the *Lookout Point and Dexter Lakes Plan of Management and Development* (USACE 1992). Maps and further details are provided in Appendix B. Lookout Point and Dexter Lakes have a combined project area totaling about 10,158 acres. Of that area, approximately 146 acres are located at two hatcheries constructed to mitigate for project-caused fish spawning and rearing habitat losses. The Willamette River Salmon Hatchery is located upstream of Lookout Point Lake near Oakridge, while the Leaburg Trout Hatchery is located along the McKenzie River. Both are operated by the ODFW. The remaining 10,012 acres of the project are located at Lookout Point and Dexter Lakes. Public lands owned outright by the Federal government total 9,280 acres, including lands acquired specifically for the project, former public domain lands that were withdrawn for project purposes, and former riverbed lands that did not have to be acquired. The remaining 732 acres are flowage easements. All of the project lands at both lakes were acquired for operational requirements, including the dam site, lake areas, construction areas, road and utility relocations, and support facilities and structures. No separable lands have been acquired at either Dexter or Lookout Point Lakes for any other purposes, including fish and wildlife management or recreation.

Much of the Lookout Point Lake lies within the boundaries of the Willamette National Forest and is managed jointly by the USACE and USFS under a MOU approved by the Secretaries of Agriculture and Army. Under the MOU, the USFS has primary management responsibility for the approximately 2,668 acres of project lands around the upper end of the lake, and joint management responsibility for the 1,880 acres of lake area within the Willamette National Forest. A total of about 564 acres at the two lakes have been leased to Lane County to operate and maintain for parks and recreation purposes. Numerous additional easements, permits, and licenses have been granted for utilities and other facilities at Dexter Lake, reflecting the predominantly urban and rural residential character of surrounding land uses. Facilities on project lands include water pumps, intakes, and pipelines, power and telephone transmission lines.

The administrative offices for the Willamette Valley Projects, as well as operations and maintenance compound for the Lookout Point and Dexter Lakes (and Fall Creek Lake) are located on the north shore of Dexter Lake, approximately 1,500 feet below the powerhouse of Lookout Point Dam. Facilities at the compound include the project office, garage, and service storage building, flammable materials storage building with fuel island, vehicle storage building, maintenance garage and a fenced service yard/outdoor storage area. Parking for the visiting public and for employees is provided on the site. The USFS Lowell Ranger Station is located in the city of Lowell on a 3.3-acre parcel of project land.

Most project recreation activity is at Dexter Lake, which is more accessible than Lookout Point Lake. At full pool, Dexter has approximately 1,030 acres of water and Lookout Point has approximately 4,250 acres. Water skiing and picnicking are especially popular at the project, with opportunities also for swimming, boating, fishing, and camping. In 1996, approximately 468,000 recreation visits were made to Lookout Point-Dexter project areas.

Most of the north shoreline of the USACE-administered portion of Lookout Point Lake is presently leased to Lane County to operate and maintain for parks and recreation purposes. The long-term leases cover a 50-year period that began in 1976. The county administers four recreation areas: Dexter Park and Lowell Park on Dexter Lake, and Landax Landing Park and Ivan Oakes Park on Lookout Point Lake. Lowell Park, located on the north shore of the lake immediately west of the Lowell city limit, is a highly developed day use recreation area. Park facilities include a hard surface, multiple lane boat launch ramp, moorage for private and rental boats, a park manager's residence, food concession building, swimming beach, parking for vehicles with and without boat trailers, flush restrooms, picnic areas, and a large area for open play. Dexter Park, located at the south abutment of the dam, is a moderately developed day use area with frontage along the shorelines of both Dexter Lake and the Middle Fork Willamette River below the Dam. Park facilities include a two-lane boat ramp at the lake, and a one-lane, unimproved ramp at the river, ski dock, parking for vehicles with or without trailers, flush and chemical toilets, picnic areas, and open play areas. Landax Landing at one time was a minimally developed recreation area with vault toilets, several picnic or camping sites with tables and fire grills, and an unimproved boat launch ramp that was usable only at full pool. While Lane County continues to hold an active lease for recreation purposes, the area has, for the most part, been abandoned and the facilities removed or deteriorated. Ivan Oakes Park is a minimally developed recreation area that formerly had approximately 21 sites. Similar to Landax Landing, facilities at the park have been removed or destroyed, however the site remains open for public use.

The only recreation site on Lookout Point Lake that is managed by the USACE is Meridian Park (formerly called North Shore Access), a minimally developed boat launch and day use area adjacent to the north abutment of Lookout Point Dam. The boat ramp at Meridian Park is currently usable only at or near full pool. Lookout Point Lake has two designated public recreation areas that are located within and operated by the Willamette National Forest. These areas, Hampton Landing Campground and Black Canyon Campground, are both located on the south shore of the lake near its eastern end. Black Canyon Campground is a moderately developed site with 72 camping spaces, three picnic areas, and a boat ramp that provides access to the Middle Fork Willamette River at the extreme upstream end of the lake. Hampton Landing is a small site with 6 camping/picnic spaces and a boat ramp that provides access to the lake at full pool.

Lookout Point is located in a narrow valley of the Cascade Mountain foothills, giving it a long, linear overall shape. The south shoreline is relatively smooth, yet steep. The Southern Pacific Railroad and Oregon State Highway 58 follow the length of the lake very closely along that shoreline, crossing the mouths of a number of major tributaries, and forming several small embayments. The largest of these are Goodman Creek, located within the USFS portion of the lake, and Rolling Riffle Creek. The northern shoreline is more convoluted, forming a number of small peninsulas and coves.

Dexter Lake is bisected by Lowell Market Road, which crosses the lake on a causeway near the middle of the lake. The north shore of Dexter Lake is gently undulating and has slopes which range from very steep near Lookout Point Dam to gently at Lowell Park. The City of Lowell is located on a small terrace that juts into the middle of the lake. As with Lookout Point, the south shoreline is dominated by Oregon State Highway 58, which is located immediately adjacent to it for most of the lake's length. Two small embayments are formed south of the highway where it crosses over low areas. The lake surface fluctuates about five feet daily, but does not suffer the seasonal drawdown typical of multi-purpose storage reservoirs.

The high degree of seasonal water level fluctuation in Lookout Point Lake (about 110 vertical feet each year) severely limits the suitability of the drawdown zone for development or management of vegetation and wildlife habitat. Under the current rule curve, the lake level will change elevation by almost one foot per day for nine months each year. During the winter months, the lake level will rise and fall with each passing storm. Under these conditions, aquatic, emergent, or riparian vegetation cannot develop or be maintained. Unlike most of the other lakes in the Upper Willamette River drainage, Lookout Point Lake does not have large marsh areas in shallow water zones. Lookout Point Lake's steep slopes and extended drawdown

limit growth of natural emergent vegetation; small patches are located in shallow embayments and upstream backwaters. Eurasian watermilfoil (*Myriophyllum spicatum*), an introduced nuisance aquatic macrophyte is found in the meander channels and sloughs below Dexter Dam. At Lookout Point, steep shorelines, extended drawdown periods, and cold water temperatures preclude serious infestations by watermilfoil and other aquatic plants.

The daily water level fluctuation that may approach five feet in magnitude at Dexter Lake does not have as serious impacts to wildlife habitat. Dexter Lake supports a large bed of aquatic vegetation, including *Potamogeton crispus*, which provides a significant amount of forage for waterfowl. There is a lack, however, of emergent vegetation that could provide suitable nesting habitat for most species of waterfowl.

Coniferous forests are the predominant vegetation community on project lands surrounding Lookout Point Lake, encompassing approximately 2,400 acres within the project area. In comparison, fewer than 10 acres of coniferous forest stands in small parcels are found at Dexter Lake. Mixed conifer-hardwood forests are found in small parcels (totaling about 653 acres) along the shoreline of Lookout Point Lake, particularly the south side. At Dexter Lake, this forest type encompasses 84 acres, while the majority of forested project lands at Dexter Lake are composed primarily of mixed conifer-hardwood and riparian hardwood forests. Of the total 232 acres of riparian hardwood (deciduous) forests stands, 167 acres are located along the shoreline of Dexter Lake and in the flat areas below Dexter Dam that are exposed to periodic flooding or a high water table. Remnants of oak Savannah community are found on project lands north of the project office below Lookout Point Dam. Upland grass-forb communities cover nearly 300 acres of project land that have been disturbed by human activity at Dexter Lake and Lookout Point Lake. Such grasslands in the parks are typically maintained by mowing to facilitate visitor use of these sites. Shrub vegetation predominates upstream from Lowell along the north shoreline of Dexter Lake, where large stands of blackberry and Scotch broom have succeeded the grass-forb community in many sites. Areas covered more or less exclusively by shrubs at the two lakes total 127 acres.

The *Lookout Point and Dexter Lakes Plan of Management and Development* (USACE 1992) identifies numerous lake-wide resource objectives that reflect the capabilities and constraints of the resources at Lookout Point and Dexter Lakes, and specify how they should be managed to help fill current and projected public needs and desires. These objectives address project operations, cooperative interagency management, improved recreation management efficiency, cooperative USACE/USFS management, USFS/USACE land interchange, low-density dispersed recreation, Eugene-to-Cascade Crest Trail, intensive day use recreation, camping, regional

interagency information center, boating, low water boat ramp, Willamette Greenway, threatened and endangered, special emphasis, sensitive, and unique species, bald eagles, Oregon chub, fisheries, wildlife species richness and diversity, black-tailed deer, waterfowl, Roosevelt elk, upland habitat, riparian mixed conifer/hardwood forests, coniferous forests, cultural resources, visual quality, water quality, environmental interpretation, and off-road vehicles. The project-wide resource objectives are detailed in Appendix B.

The Master Plan delineates land use classification for 9,269 acres of project lands. These designated land use classifications include project operations (52 acres), recreation (247 acres), environmentally sensitive area (424 acres), low-density recreation (379 acres, vegetation management (2,423 acres), wildlife management (200 acres), future recreation (240), and water (5,252 acres). The USACE project lands at the Lookout Point Lake and Dexter Lake are also divided into 12 and 8 management units, respectively. In the Master Plan, each management unit is described with regard to location, access, existing site uses, adjacent land uses, vegetation, wildlife, cultural resources, and limitations and hazards. The Master Plan also identifies the designated management unit objectives (and rationale) and specific management and development concepts for the unit. Those management units with objectives that relate to plant and wildlife resources are described in Appendix B.

The only known listed and proposed threatened or endangered wildlife and plant species documented at Dexter Lake is the bald eagle. However, the northern spotted owl may occur in the broader resource area surrounding the project. Species of concern and candidate species documented at Dexter Lake include northwestern pond turtle and Howell's montia.

Listed and proposed threatened or endangered wildlife and plant species documented at Lookout Point Lake include bald eagle and northern spotted owl. Species of concern or candidate species documented at Lookout Point include the peregrine falcon (*Falco peregrinus*), northern red-legged frog, foothills yellow-legged frog, northwestern pond turtle, and Howell's montia.

2.9 DESCRIPTION OF DORENA PROJECT

2.9.1 Project Information

Dorena Dam is located on the Row River about 6 miles east of Cottage Grove, Oregon. The dam has been operated since 1949 and controls runoff from a 265-square mile drainage area. A schematic diagram of Dorena Dam is included in Appendix A. As of September 1996, total construction costs were $14,568,300 and operation and maintenance costs $9,371,300, for a total federal cost of $23,939,600. There are no hydropower facilities at Dorena Dam. The average

annual number of recreational visits to Dorena Lake is estimated by OWRD (1999) to be 343,000.

There are five regulating outlets at Dorena Dam. The spillway crest is approximately 115 feet above the tailwater elevation at Dorena Dam, and there are no gates present to control spill with.

2.9.2 Passage, Protection, Mitigation, and Enhancement Measures for Fish

There are no provisions for fish passage at Dorena Dam, as it was concluded around the time of construction that the Row River did not support a significant, if any, run of migratory fish prior to construction (Craig and Townsend 1946). The section of the Row River to be inundated was considered to be unfavorable to resident trout, which were also thought to be blocked by Wild Wood Falls, located about five miles upstream of the proposed upstream end of the reservoir (Holmes 1939). It was thus determined that the existing fish life of the watershed would not be adversely affected by the project and no mitigation was required.

Dorena Reservoir is generally not drafted for flow augmentation in the mainstem Willamette River because the amount of storage is relatively small. Minimum flow releases of 250 cfs in June and 100 cfs in July and August are part of the state of Oregon's water management objectives.

2.9.3 USACE Project Lands

This summary of USACE project lands at the Dorena Lake project is based upon the *Dorena Lake Plan of Management and Development* (USACE 1989b). Maps and further details are provided in Appendix B. Federal lands at the Dorena Lake project total 2,555 acres. Of this total, the Federal Government owns in fee 2,483 acres. The remaining 72 acres are flowage easements. Most project lands (2,514 acres) were acquired for the requirements of project operation, including lands needed for the dam site, lake area, construction areas, roads, utility relocations, and support facilities and structures. Forty-one acres are separable recreation lands acquired specifically for recreation purposes. The project contains no separable lands acquired for fish and wildlife management or mitigation.

Dorena Lake has fairly diverse habitats for attracting and maintaining wildlife, however, wildlife use is limited by the fluctuations in lake levels, coupled with the narrowness, limited extent, and bisection of project lands by roads limit. The primary vegetative cover along the lake is second-growth coniferous forest dominated by Douglas fir. Mixed conifer-hardwood, deciduous forest,

and riparian woodlands also occur around the perimeter of the lake. The deciduous forest occurs in low-lying areas, where bigleaf maple, red alder, and willow comprise the overstory, while conifers are scattered throughout these stands. A complex of upland forest, marsh, and riparian habitats typify Teeter Creek on the east side of Dorena Lake, and the southeast and northwest ends of the lake. Other habitats at Dorena Lake include marshland, shrubs, grasslands, and disturbed areas. Each of the major habitat types at Dorena Lake is described in Appendix B.

Six parcels totaling 212 acres of land and water, are leased to Lane County to operate and maintain for parks and recreation purposes. Perpetual easements have been granted to Lane County for rights-of-way for segments of Row River Road and Government Road. Bohemia Inc., through the Oregon Pacific and Eastern (OP&E) Railroad has been granted a perpetual easement for the relocated railway track along the north side of the lake. In addition, several small parcels around the project have been outgranted for private road access, power lines, and other utilities.

Seven sites at Dorena Lake are designated for public recreation. The USACE and Lane County have developed three of these. Popular recreational activities at the project are water skiing, boating, and swimming. Lane County operates Harms and Baker Bay Parks. These parks have facilities for picnicking and boat launching. Baker Bay also provides overnight camping, and is the largest, most highly developed park at Dorena Lake. Schwarz Park is operated by the USACE. It is just downstream of the dam and provides a minimally developed campground with river access. Overall, Dorena Lake offers 122 campsites, 29 picnic sites, 3 boat launch lanes, a marina with 27 seasonal moorage spaces, courtesy boat docks, play areas, restrooms with showers, and other related facilities. Four other sites leased to Lane County are also designated as parks, but are undeveloped. These include the Bake-Stewart (22 acres), Vaughn (33 acres), Row Point (12 acres), and Teeter Creek (34 acres). In 1996, about 433,300 recreation visits were made to the Dorena Lake project.

Dorena Lake Plan of Management and Development (USACE 1989b) (Master Plan) identifies numerous lake-wide resource objectives that reflect the capabilities and constraints of the lake's resources and specify how they should be managed to help fill current and projected public needs and desires. These objectives address project operations, boating, day-use recreation, trails, low-density dispersed recreation, visual resource and open space management, water quality, threatened or endangered plants, unique, threatened or endangered animals, waterfowl, big game management, wildlife richness and diversity, upland gamebirds, fisheries, cultural resources, and interpretation. These are detailed in Appendix B.

The Dorena Lake Master Plan identifies the land use classification for 781 acres of project lands. These designated land use classifications include project operations (180 acres), recreation (76 acres), future and/or inactive recreation (6 acres), low-density recreation (83 acres), vegetation management (195 acres), wildlife management (169 acres), and flowage easements (72 acres). At full pool, the lake surface occupies approximately 1,750 acres. The USACE project lands at Dorena Lake are also divided into 11 distinct management units. In the Master Plan, each management unit is described with regard to location, access, existing site uses, adjacent land use, vegetation, wildlife, cultural resources, and limitations and hazards. The Master Plan also identifies the designated management unit objectives (and rationale) and specific management and development concepts for the unit. Those management units with objectives that relate to plant and wildlife resources are described in Appendix B.

Bald eagles are the only known listed and proposed threatened or endangered wildlife and plant species documented at Dorena Lake. However, northern spotted owls and Canada lynx may occur in the broader resource area surrounding the project. Species of concern and candidate species documented at Dorena Lake include northwestern pond turtle, Howell's montia, and shaggy horkelia (*Horkelia congesta* ssp. *congesta*).

2.10 DESCRIPTION OF COTTAGE GROVE PROJECT

2.10.1 Project Information

The Cottage Grove project is located on the Coast Fork Willamette River about 6 miles south of Cottage Grove, Oregon. The dam has been operated since 1942 and controls runoff from a 104-square mile drainage area. A schematic diagram of the dam is included in Appendix A. As of September 1996, total construction costs were $4,013,100 and operation and maintenance costs $14,594,600, for a total federal cost of $18,607,700. There are no hydropower facilities at the project. The average annual number of recreational visits to Cottage Grove is estimated by OWRD (1999) to be 417,000. There are five recreation facilities at the site that are used to capacity during peak summer use periods. Because of its limited summer storage (28,700 acre-feet), the lake is not drafted to meet flow requirements on the mainstem Willamette River during the summer.

The spillway crest is approximately 97 feet above the tailwater elevation at Cottage Grove Dam, and there are no gates present to control spill.

2.10.2 Passage, Protection, Mitigation, and Enhancement Measures for Fish

There are no provisions for fish passage at Cottage Grove Dam, as it was concluded around the time of construction that the Coast Fork Willamette River did not support a significant, if any, run of migratory fish prior to construction (Craig and Townsend 1946). The section of the Coast Fork Willamette River to be inundated was considered to be unfavorable to resident trout, which were also blocked by a water diversion dam operated by a lumber mill (Holmes 1939). It was thus determined that the existing fish life of the watershed would not be adversely affected by the project and no mitigation was required.

Cottage Grove Reservoir is generally not drafted for flow augmentation in the mainstem Willamette River because the amount of storage is relatively small. Minimum flow releases of 75 cfs in June and 50 cfs in July and August are part of the state of Oregon's water management objectives.

In 1966, 1971, and 1974 the lake was dropped to streambed and poisoned to control rough fish. During this time, Cottage Grove Lake was used as a summer rearing pond for juvenile chinook salmon. The program was eliminated in 1976 when research indicated that excessive levels of mercury and other heavy metals were being bioaccumulated in the salmon. The elevated metal levels influenced the ability of the fish to smolt and adapt to the salt water environment.

2.10.3 USACE Project Lands

This summary of USACE lands at the Cottage Grove Lake project is based upon the *Cottage Grove Lake Plan of Management and Development* (USACE 1989c) (Master Plan). Maps and further details are provided in Appendix B. Cottage Grove Lake controls runoff from a 104 square mile area drained by the Coast Fork Willamette River. The Cottage Grove Lake Project contains a total of 1,547 acres, of which the Federal Government owns in fee 1,537 acres. The remaining 10 acres are flowage easements located along the Coast Fork Willamette River at the upstream end of the lake. All project lands were acquired for operational requirements, including the dam site, lake area, construction areas, road and utility relocations, and support facilities and structures. No separable lands have been acquired at Cottage Grove Lake for any other purposes, including fish and wildlife management or recreation.

Some areas the project have been outgranted to other agencies, entities, or individuals to be managed for uses consistent and compatible with authorized project purposes. The outgrants convey varying rights and responsibilities for management of project resources to the

outgrantees. The outgranted lands are predominantly used for transportation and utility rights-of-way. Generally, these instruments allow the outgrantee rights to construct, use, operate, and maintain roadways or utilities crossing project lands for a variety of purposes. Lane County holds an easement for roads on each side of Cottage Grove Lake. Weyerhaeuser Corporation holds an easement for a truck-line logging road along the west side of the lake. Additional easements have been authorized to Emerald People's Utility District and California-Oregon Power Company. A small (2.5 acre) sewage-treatment irrigation field adjacent to the project sewage lagoon downstream of the dam is grazed by sheep under a lease agreement to help maintain the field and eliminate the need for periodic mowing.

The lake and its shoreline are used for boating, swimming, picnicking, camping, fishing, and hunting (waterfowl). There are six recreation areas at the Cottage Grove Lake project. Camping is provided at the Pine Meadows Campground and Primitive Campground (totaling approximately 120 campsites). Three moderately developed day-use parks, Wilson Creek, Lakeside, and Shortridge, provide for activities such as swimming, picnicking (126 sites), fishing, and water skiing. Three boat launch lanes, 3 courtesy boat docks, and 3 swimming beaches are provided at these sites. Riverside Park is a minimally developed public access point along the river below the dam. In 1996, about 558,600 recreation visits were made to the Cottage Grove project.

Approximately 133 acres of project land are occupied by coniferous forest, while 41 acres are deciduous forest. Shrubby upland vegetation comprises approximately 15 acres of project lands, while grasslands and disturbed areas comprise 93 and 96 acres, respectively. Lakeside habitat at the Cottage Grove project also includes extensive marshlands (approximately 193 acres) including those areas around the mouths of tributary Wilson and Cedar Creeks. These marshlands areas are typified by extensive stands of reed canarygrass interspersed with common thistle, spiraea, rose, soft rush, spike rush, and sedges.

The Master Plan identifies numerous lake-wide resource objectives that reflect the capabilities and constraints of Cottage Grove Lake's resources and specify how they should be managed to help fill current and projected public needs and desires. These objectives address project operations, boating, day-use recreation, trails, low-density dispersed recreation, visual resource and open space management, water quality, special emphasis, threatened, and endangered wildlife species, threatened or endangered plant species, waterfowl, big game management, wildlife richness and diversity, upland gamebirds, fisheries, cultural resources, and interpretation, and are detailed in Appendix B.

The Master Plan identifies the land use classification for 410 acres of project lands. These designated land use classifications include project operations (90 acres), recreation (109 acres), wildlife management (133 acres), vegetation management (68 acres) and flowage easements (10 acres). The remaining lands are easements or open water.

The USACE project lands at the Cottage Grove Lake Project are also divided into 11 management units. In the Master Plan, each management unit is described with regard to location, access, existing site uses, adjacent land use, vegetation, wildlife, cultural resources, and limitations and hazards. The Master Plan also identifies the designated management unit objectives (and rationale) and specific management and development concepts for the unit. Those management units are described in Appendix B.

The bald eagle is the only identified listed and proposed threatened or endangered wildlife and plant species documented at Cottage Grove Lake. Species of concern and candidate species documented at the project include long-eared myotis and wayside aster (*Aster vialis*).

2.11 DESCRIPTION OF FERN RIDGE PROJECT

2.11.1 Project Information

The Fern Ridge project is located on the Long Tom River, a tributary of the Willamette River, about 12 miles west of Eugene in Lane County, Oregon. The dam has been operated since 1941 and controls runoff from a 275-square mile drainage area. A schematic diagram of the dam is included in Appendix A. As of September 1996, total construction costs were $8,685,600 and operation and maintenance costs $20,116,100, for a total federal cost of $28,801,700. Fern Ridge Lake is on of the two most popular of all the USACE facilities for recreation, and the average annual number of visits is estimated by OWRD (1999) to be 768,000. The lake is not drafted to meet instream flow requirements on the mainstem Willamette River during the summer because of its high priority for recreation, but is required to meet minimum flow targets in the summer months at Monroe on the Long Tom River. The dam is not authorized for future power generation.

The reservoir is drawn down to minimum stage during the months of December and January to give full flood control reservation during this period. The reservoir is filled gradually during the spring months so that it will normally be full by May 1 of each year. The stored water is released during periods of low runoff, usually from July to September. Dam releases

correspondingly vary between meeting a minimum instream flow of 30 cfs at Monroe and 2,200 cfs. There are five regulating outlets at Fern Ridge Dam.

The spillway crest is approximately 25 feet above the tailwater elevation at Fern Ridge Dam, with six spill gates.

2.11.2 Passage, Protection, Mitigation, and Enhancement Measures for Fish

There are no provisions for fish passage at Fern Ridge Dam, as it was concluded around the time of construction that the Long Tom River did not support either migratory or resident salmonids prior to construction (US Engineer Office 1939; Craig and Townsend 1946; Needham et al. 1948). It was thus determined that the existing fish life of the watershed would not be adversely affected by the project and no mitigation was required.

The ODFW manages 5,000 acres of land and water for migratory waterfowl under license agreement. In July 1993, the ODFW initiated three waterfowl impoundments, Fern Ridge, Long Tom River, and Fisher Butte waterfowl impoundments, to restore 115 acres on the east shore of Fern Ridge Lake for waterfowl management. The modifications were allowed under the provisions set forth in Section 1135 of the Water Resources Development Act of 1986. Total modification costs were $210,700.

2.11.3 USACE Project Lands

This summary of USACE project lands at the Fern Ridge Lake project is based upon the *Fern Ridge Lake Plan of Management and Development* (USACE 1988) (Master Plan). Maps and further details are provided in Appendix B. The Fern Ridge Lake project lands are very flat, with elevations ranging from 373.5 to 378 feet, and slopes generally ranging from 0 to 7 percent. The Fern Ridge Lake Project contains a total of 12,780 acres that are either owned in fee by the Federal Government, or for which flowage or other types of easement rights have been acquired. A total of 11,810 acres are project fee-owed lands that were acquired outright for the project. Along the Long Tom River downstream of the dam, easements for channel improvements were acquired on 776 acres. The remaining 193 acres are flowage easements around the lake.

Of the total project area, 12,555 acres (including both fee and easement lands) are allocated, or were acquired for project operations requirements. These lands include the dam site, lake area, project construction areas, road system relocations, and support facilities and structures. The remaining 225 acres of project area are separable recreation lands acquired between 1964 and

1969 specifically for recreation purposes. These lands are in four parcels around the lake or within or adjacent to developed park sites. The project contains no separable lands acquired for fish and wildlife management or mitigation. Large areas of project lands have been outgranted to other agencies and organizations for uses compatible with project purposes. More than 5,000 acres, including 1,384 acres of land and 3,626 acres of water, are licensed to the ODFW which, in cooperation with the USACE, manages the area for wildlife, particularly migratory waterfowl.

Fern Ridge Lake has become an extremely popular area for swimmers, boaters, and other users, even though recreation was not originally an authorized primary project purpose. It receives heavy use for picnicking, swimming, sailing, water skiing, and fishing. In 1996, about 845,700 recreation visits were made to Fern Ridge. The USACE operates Perkins Peninsula and Kirk Parks. Orchard Point, Richardson Park, and Zumwalt Park, totaling 362 acres, are leased to Lane County for parks and recreation purposes. A total of 17 acres are leased to the Eugene Yacht Club and Tri-Pass ski Club, quasi-public organizations providing recreation facilities for members. A 7-acre parcel on Jean's Peninsula is leased to a private concessionaire who, for a fee, provides day use and camping facilities, and boat moorage. Education leases for two sites totaling 38 acres have been granted to Bethel School District and Eugene School District 4J for environmental interpretation and other educational purposes. In addition to those outgrants, permits have been granted to adjacent landowners for certain private and exclusive uses of project lands. Permitted activities include private boat docks, moorage facilities, and landscaping. There are 24 private boat docks and three community docks presently permitted along the lakeshore. Livestock watering rights have also been reserved for adjacent landowners in several areas around the lake.

Fern Ridge Lake is a wide, shallow, multi-purpose reservoir. The lake is irregularly shaped and has a large peninsula on the south shoreline between the channels of the Long Tom River and Coyote Creek. The lake and adjacent USACE lands encompass a variety of vegetative communities. The mixture of riparian forest, coniferous forest, oak woodland, emergent marsh communities (cattail, bulrush, and reed canarygrass), grasslands, shrub lands, (early to intermediate seral stage), agricultural lands, mudflat and open water habitats provide components appropriate for many species of wildlife. The major habitat types on Fern Ridge project lands include upland grassland (373 acres), lowland grassland (943 acres), reed canarygrass marshland (2,248 acres), shrub habitats (158 acres) deciduous forest (830 acres), and coniferous forest (275 acres). Eurasian watermilfoil is found along the shores of Fern Ridge Reservoir, in the Long Tom River, and in Coyote Creek. A heavy infestation exists in Kirk Pond.

The Master Plan identifies 16 lake-wide resource objectives that reflect the capabilities and constraints of Fern Ridge Lake's resources and specify how they should be managed to help fill current and projected public needs and desires. These objectives address project operations, boating, day-use recreation, trails, low-density dispersed recreation, visual resource and open space management, water quality, threatened or endangered plants, unique, threatened, or endangered animals, waterfowl, big game, wildlife richness and diversity, upland gamebirds, fisheries, cultural resources, and interpretation. The project-wide resource objectives are detailed in Appendix B.

The Master Plan identifies the land use classification for 3,597 acres of project lands. These designated land use classifications include project operations (121 acres), environmentally sensitive areas (182 acres), recreation (299 acres), low density recreation (193 acres), inactive and/or future recreation (81 acres), wildlife management (2,721 acres), and flowage easements (164 acres). The remaining lands are easements or open water. The USACE project lands at Fern Ridge Reservoir are also divided into 19 management units. In the Master Plan, each management unit is described with regard to location, access, existing site uses, adjacent land use, vegetation, wildlife, cultural resources, and limitations and hazards. The Master Plan also identifies the designated management unit objectives (and rationale) and specific management and development concepts for the unit. The management units are described in Appendix B.

Of all the 13 Willamette Basin projects, Fern Ridge has the greatest abundance and diversity of listed threatened and endangered plant and wildlife species, as well as those that are candidates or species of concern. The following are known to occur at Fern Ridge Lake: bald eagle, Bradshaw's desert parsley (*Lomatium bradshawii*), white-topped aster (*Aster curtus*), Willamette daisy (*Erigeron decumbens* var. *decumbens*), Kincaid's lupine (*Lupinus sulphureus* ssp. *kincaidii*), Fender's blue butterfly (*Icaricia icaroides fenderi*), wayside aster (*Aster vialis*), peregrine falcon (non-breeding), northern red-legged frog, northwestern pond turtle, long-eared myotis, fringed myotis, shaggy horkelia, Howell's montia, little willow flycatcher (*Empidonax traillii brewsteri*), olive-sided flycatcher (*Contopus borealis*), and streaked horned lark (*Eremophila alpestris strigata*).

2.12 BANK PROTECTION PROGRAM

Bank erosion in the Willamette system is not new and current problems are not much different than those occurring over the past 100 years. The Flood Control Acts of 1936, 1938, 1950 authorized the Willamette River Bank Protection Program to allow for 450,000 linear feet of protection works. The program acts to prevent bank erosion, which destroys productive

farmland, roads, bridges, and other improvements. In 1971, the Senate and House Committees on Public Works expanded the program's scope to 510,000 linear feet. The 1950 WRDA required local sponsorship for any new bank protection projects, and it transferred responsibility for maintenance of revetments constructed after 1950 from the USACE to the local sponsor. Maintenance activities include vegetation control among revetment structures, which in the past has included the application of herbicides. Under the Willamette River Vegetation Maintenance Demonstration Project, bank protection works were classified in part according to the state of vegetation. Bank structures that were classified as being at high risk of damage or destruction, or where the feature being protected was of high value, were not allowed to support vegetation that would hinder aerial inspection or have a reasonable chance of impacting structural integrity. Over the past few years, inspection letters to sponsors have not made any vegetation removal requirements.

About 489,800 linear feet of erosion protection has been provided at 230 locations in the system. These projects are commonly rock revetments constructed of heavy quarry stone placed on river banks to keep them from being eroded by the force of flowing water, wind, and/or wave action. Construction specifications have normally called for the use of Class III riprap, where stone weights are generally less than 800 lbs, of which at 30 percent by weight are heavier than 400 lbs (USACE 1975). There are three main erosive processes in the Willamette River and tributaries that include bank scour, bank failure resulting from changes to surface soil conditions; and bank failure resulting from change in bank support. Greater details are provided in Weber (1989) and USACE (1999b). Table 2-11 summarizes the character and extent of bank protection works in the Willamette River basin directly or indirectly related to the Willamette Project. Although there are bank protection structures present below RM 59.6, they are not part of the Willamette Project and are not maintained by the USACE. New erosion areas, tabularized in USACE (1999b), are associated primarily upstream or downstream of existing revetments or on the outside bends of unprotected reaches. The Willamette River Floodplain Restoration Study (see Chapter 1) will identify opportunities for correcting bank erosion problems in the future.

Table 2-11. List of bank protection structures associated directly or indirectly with USACE activities in the Willamette River basin.

River	Name	River Mile	Bank	Length	Structure Type	Year Constructed	Construction Authority	Maintenance Agreement	Maintenance Category	Maintenance Deficient	Comments
WR	WESTON BEND	59.6	R	5500	STONE	38	FCA (U)	N	3C	N/A	NONE
WR	UPPER JACKSON BEND	64.0	L	752	STONE/CONC.& W.BARR.	63	R & H	N	3B	N/A	MAINTENANCE NOT AUTHORIZED
WR	LAMBERT SLOUGH	64.9	R	370	STONE	38	FCA (U)	N	4D	N/A	NONE
WR	STOUTENBERG	65.6	L	3914	STONE	52	FCA (U)	N	3C	N/A	NONE
WR	STOUTENBERG U/S EXT.	66.3	L	587	CLASS III	74	FCA (S)	Y	3B	N	NONE
WR	SNAGGY BEND	67.5	L	700	CLASS III & PILE	43	R & H	N	3C	N/A	MAINTENANCE NOT AUTHORIZED
WR	DITMARS BEND	68.1	R	6350	STONE	38	FCA (U)	N	3C	N/A	NONE
WR	GRAND ISLAND	69.1	L	2430	STONE	38	FCA (U)	N	3C	N/A	NONE
WR	ELDRIEDGE BAR	69.9	R	1445	CLASS III	62	FCA (S)	Y	3B	N	NONE
WR	WHEATLAND DAM(LOC B)	71.0	L	1184	STONE	38	FCA (U)	N	4D	N/A	NONE
WR	LOCATION A D/S EXT.	71.2	L	2002	STONE	58	FCA (S)	Y	4D	N	NONE
WR	LOCATION A	71.2	L	1886	STONE	38	FCA (U)	N	4D	N/A	NONE
WR	BECHTOLD	71.9	R	2759	STONE	48	FCA (U)	N	3D	N/A	NONE
WR	H. L. PEARCY	75.9	R	2075	STONE & ASPHALT	48	FCA (U)	N	4D	N/A	NONE
WR	KEIZER RAPIDS	80.2	R	2408	STONE	40	FCA (U)	N	1B	N/A	NONE
WR	SPONG ROAD	80.6	R	1228	CLASS III	75	FCA (S)	Y	2B	N	NONE
WR	MINTO-BROWN	85.5	R	3645	CLASS III	85	FCA (S)	Y	3A	N	NONE
WR	EOLA BEND	88.0	L	2900	STONE	38	FCA (U)	N	2D,4D	N/A	NONE
WR	GRAY EAGLE BAR	88.4	R	4725	STONE	39	FCA (U)	N	3C	N/A	NONE
WR	EYERLY	89.2	R	2229	STONE	48	FCA (U)	N	3d	N/A	NONE
WR	BUDDS CHUTE	91.3	L	2053	STONE	48	FCA (U)	N	3C	N/A	NONE
WR	INDEPENDENCE BEND	94.1	L	6500	STONE & STEEL BARR.	03	EMERGENCY	N	3C	N/A	MAINTENANCE NOT AUTHORIZED
WR	INDEPENDENCE BRIDGE	96.6	L	1820	CLASS III	81	FCA (S)	Y	3B	N	NONE
WR	KENTUCKY BAR	96.9	L	740	STONE	57	R & H	N	3C	N/A	MAINTENANCE NOT AUTHORIZED
WR	DENLINGER	97.0	L	443	STONE	55	FCA (S)	Y	3D	N	NONE
WR	PROBST	97.4	L	1878	STONE	38	FCA (U)	N	3C	N/A	NONE
WR	MURPHYS BAR	97.7	R	3339	GRAVEL AND W. BARR.	47	FCA (U)	N	3D	N/A	NONE
WR	MURPHYS BAR U/S EXT.	98.4	R	1128	STONE & STEEL BARR.	57	FCA (S)	Y	3C	N	NONE
WR	HOOVER	100.1	L	2253	CLASS II	59	FCA (S)	Y	3D	N	NONE
WR	AMERICAN BOTTOM	104.2	L	1860	DRIFT BARRIER	66	FCA (S)	Y	3A	N	NONE
WR	CATLIN	104.7	L	366	STONE & WOOD BARR.	49	FCA (U)	N	4D	N/A	NONE

Table 2-11. List of bank protection structures associated directly or indirectly with USACE activities in the Willamette River basin.

River	Name	River Mile	Bank	Length	Structure Type	Year Constructed	Construction Authority	Maintenance Agreement	Maintenance Category	Maintenance Deficient	Comments
WR	BLACK DOG BAR	111.1	L	3384	STONE & WOOD BARR.	48	FCA (U)	N	3D	N/A	NONE
WR	UFFORD	115.9	L	1924	STONE	47	FCA (U)	N	3B	N/A	NONE
WR	BOWERS ROCKS	122.2	L	930	STONE	68	R & H	N	3C	N/A	MAINTENANCE NOT AUTHORIZED
WR	COON CREEK	123.1	R	3270	CLASS III & IV	62	R & H	N	3C	N/A	MAINTENANCE NOT AUTHORIZED
WR	LITTLE WILLAMETTE	123.8	L	2718	CLASS III	64	R & H	N	3C	N/A	MAINTENANCE NOT AUTHORIZED
WR	SCATTER BAR	124.4	R	2700	STONE	56	R & H	N	3B	N/A	MAINTENANCE NOT AUTHORIZED
WR	HALF MOON BEND	125.2	L	5536	STONE	48 & 54	FCA (U) & (S)	Y	3C	N	SPONSOR-STONE APRON ONLY
WR	UPPER HALF MOON BEND	126.3	R	5266	STONE	49	FCA (U)	N	3B	N/A	NONE
WR	DIXON CREEK EXT.	130.2	L	2320	CLASS III	81	FCA (S)	Y	1A	N	RM 130.2 868LF,RM 130.6 1452LF
WR	DIXON CREEK	130.3	L	1665	CLASS II	60	FCA (S)	Y	1B	N	NONE
WR	CITY OF CORVALLIS	132.0	L	414	STONE & TIMBER PILE	39	FCA (U)	N	3D	N/A	NONE
WR	CORVALLIS	133.0	R	3310	CLASS III	48	FCA (U)	N	3C	N/A	NONE
WR	HOUT	133.8	L	2314	STONE	55	FCA (S)	Y	1A	N	NONE
WR	HOUT U/S EXT. PHSE I	134.3	L	1219	CLASS III	76	FCA (S)	Y	1A	N	NONE
WR	HOUT U/S EXT PHSE II	134.5	L	3500	CLASS III	79	FCA (S)	Y	3B	N	NONE
WR	STALLBUSH ISLAND	135.0	R	2673	STONE	53	FCA (S)	Y	3C	N	NONE
WR	BASS LOCATION PHS II	135.7	R	2024	8 GROINS	83	FCA (S)	Y	3B	N	NONE
WR	BASS LOC. PHSE I	136.0	R	2495	CLASS III	81	FCA (S)	Y	3B	N	NONE
WR	BROWN BEND	136.1	L	2066	STONE	47	FCA (U)	N	3D	N/A	NONE
WR	KIGER BEND	136.3	R	750	STONE	48	FCA (U)	N	4D	N/A	NONE
WR	CANNON	136.8	R	2450	CLASS III	84	FCA (S)	Y	3A	N	NONE
WR	DANIS	137.0	L	2976	CLASS III	74	FCA (S)	Y	3D	N	NONE
WR	HATHAWAY (MID. CH.)	137.6	R	1503	STONE	53	FCA (S)	Y	4C	N	NONE
WR	JOHN SMITH ISLAND	137.7	L	1488	STONE & STEEL BARR.	51	FCA (U)	N	4D	N/A	NONE
WR	CENTENNIAL ISLAND	138.6	L	3373	CLASS III,DRIFT BARR	64	FCA (S)	Y	3B	N	NONE
WR	ROWLAND	139.4	R	3321	CLASS III	68	FCA (S)	Y	3A	N	NONE
WR	W.W. SMITH ESTATE	141.6	L	3763	STONE & STEEL BARR.	56	FCA (S)	Y	3C	N	NONE
WR	PORTER	142.8	L	1886	CLASS III	64	FCA (S)	Y	3D	Y	NONE
WR	PORTER	142.8	R	1100	CLASS III	64	FCA (S)	Y	3D	Y	NONE
WR	JACOBS BEND	144.5	R	3441	STONE	47	FCA (U)	N	3B	N/A	NONE
WR	JACOBS BEND U/S EXT	145.1	R	1925	CLASS III	59	FCA (S)	Y	3C	Y	NONE

Table 2-11. List of bank protection structures associated directly or indirectly with USACE activities in the Willamette River basin.

River	Name	River Mile	Bank	Length	Structure Type	Year Constructed	Construction Authority	Maintenance Agreement	Maintenance Category	Maintenance Deficient	Comments
WR	SAM DAWS BEND	145.7	L	2753	STONE	62	FCA (S)	Y	3B	N	NONE
WR	TRENHOLM	148.1	L	962	CLASS III	63	FCA (S)	Y	3B	N	NONE
WR	LOWER BEND D/S EXT	151.5	L	1936	CLASS III & ST. BAR.	63	FCA (S)	Y	3C	Y	SPONSOR ON DEFICIENT LISTING
WR	LOWER BEND	151.8	L	3506	STONE	49	FCA (U)	N	3C	N/A	NONE
WR	IRISH BEND	153.7	L	2530	STONE & WOOD BARR.	38	FCA (U)	N	3C	N/A	NONE
WR	FAWVER ISLAND	154.1	L	2371	STONE	55	FCA (S)	Y	3C	N	NONE
WR	INGRAM ISLAND	156.3	L	2433	STONE	39	FCA (U)	N	3D,1D	N/A	NONE
WR	FOSTER	156.8	L	4005	STONE	58	FCA (S)	Y	3B	N	NONE
WR	ALFORD	157.4	R	1916	STONE	48	FCA (U)	N	4B	N/A	NONE
WR	FOSTER U/S EXT.	157.5	L	1726	CLASS III	71	FCA (S)	Y	3C	N	NONE
WR	MORGAN BEND	159.2	L	1380	STONE	47	FCA (U)	N	4D	N/A	NONE
WR	CITY OF HARRISBURG	160.9	R	1694	STONE	48	FCA (U)	N	1A	N/A	NONE
WR	BOGGS	161.4	L	816	CLASS III	67	FCA (S)	Y	3C	Y	SPONSOR HAS DISBANDED
WR	GAVETTE	161.5	L	2249	STONE & STEEL BARR.	58	FCA (S)	Y	3D	Y	SPONSOR HAS DISBANDED
WR	GAVETTE U/S EXT.	161.8	L	435	CLASS III	65	FCA (S)	Y	3D	Y	SPONSOR HAS DISBANDED
WR	FORGAY	162.3	R	930	CLASS III	63	FCA (S)	Y	3C	N	NONE
WR	HARRISBURG BEND	162.7	R	2218	STONE & ASPHALT	37	EMERGENCY	N	4D	N/A	MAINTENANCE NOT AUTHORIZED
WR	HARRISBURG RR BR APP	162.8	L	972	STONE	48	FCA (U)	N	1C	N/A	NONE
WR	HARRISBURG RR BR U/S	163.0	L	1354	CLASS III	64	FCA (S)	Y	3D	N	NONE
WR	HARPER BEND	163.6	L	2601	STONE & ASPHALT	47	FCA (U)	N	3C	N/A	NONE
WR	HARPER BEND U/S EXT	164.1	L	2594	STONE	58	FCA (S)	Y	3B	N	NONE
WR	MORSE	164.2	R	2474	CLASS III & W. BARR.	62	FCA (S)	Y	3B	N	NONE
WR	SAWER	164.8	R	1526	CLASS III	70	FCA (S)	Y	3B	N	NONE
WR	JUNCTION CITY	165.2	L	451	CLASS III	65	FCA (S)	Y	3D	N	NONE
WR	KOON	166.3	L	1322	CLASS III	64	FCA (S)	Y	3D	N	NONE
WR	KOON U/S EXT.	166.5	L	1021	CLASS III & W. BARR.	73	FCA (S)	Y	3C	N	NONE
WR	LOCATION NO. 9	167.0	L	2615	STONE	39	FCA (U)	N	3B,3D	N/A	NONE
WR	LOC. NO. 9 U/S EXT.	167.5	L	2155	STONE	52	FCA (U)	N	4D	N/A	NONE
WR	LOC. 8A D/S EXT.	167.7	R	938	CLASS III & W. BARR.	65	FCA (S)	Y	3C,3B	N	NONE
WR	LOCATION 8A	168.0	R	3880	STONE	38	FCA (U)	N	4D,3D	N/A	NONE
WR	MARSHALL ISLAND	168.8	L	4218	CLASS III & IV	63	FCA (S)	Y	3D	N	NONE

Table 2-11. List of bank protection structures associated directly or indirectly with USACE activities in the Willamette River basin.

River	Name	River Mile	Bank	Length	Structure Type	Year Constructed	Construction Authority	Maintenance Agreement	Maintenance Category	Maintenance Deficient	Comments
WR	FERTILE DIST.(LOC 8)	169.5	R	4000	STONE	39	FCA (U)	N	4D,1B	N/A	NONE
WR	LOCATION 7A	170.4	L	3650	CLASS III	38	FCA (U)	N	4D,3B	N/A	NONE
WR	KELSO	172.0	L	2108	CLASS III & W. BARR.	60	FCA (S)	Y	3D	N	NONE
WR	LASSEN	172.0	L	1717	CLASS III & W. BARR.	74	FCA (S)	Y	3C	N	NONE
WR	LOCATION 7 D/S EXT	173.6	L	2428	STONE & WOOD. BARR.	55	FCA (S)	Y	3D,3B	N	NONE
WR	LOCATION 7	174.0	L	1055	STONE	44	EMERGENCY	N	3D	N/A	MAINTENANCE NOT AUTHORIZED
WR	ROGERS BEND	174.1	L	682	STONE	46	EMERGENCY	N	2B	N/A	MAINTENANCE NOT AUTHORIZED
WR	LOCATION 6	175.0	L	2179	STONE	44	EMERGENCY	N	4D	N/A	MAINTENANCE NOT AUTHORIZED
WR	MACLAY PLACE D/S EXT	176.0	L	923	CLASS III	68	FCA (S)	Y	2B,3C	N	NONE
WR	MACLAY PLACE	176.3	L	1720	ST. & ASPH & W. BARR	47	FCA (U)	N	4A,3C	N/A	NONE
WR	LOWER GOODPASTURE	178.0	R	3400	STONE	38	FCA (U)	N	1C,1B	N/A	NONE
WR	WILBUR BEND	178.3	L	1350	STONE & ASPHALT	47	FCA (U)	N	1C	N/A	NONE
WR	UPPER GOODPASTURE	179.4	R	3850	STONE & WOOD. BARR.	39	FCA (U)	N	1C	N/A	NONE
WR	BAUER LANE D/S EXT	179.7	L	1005	STONE & ASPHALT	47	FCA (U)	N	1C	N/A	NONE
WR	BAUER LANE	180.1	L	2130	STONE	44	EMERGENCY	N	3D	N/A	MAINTENANCE NOT AUTHORIZED
WR	FERRY ST. BR. D/S EX	182.0	R	385	STONE	48	EMERGENCY	N	1C	N/A	NONE
WR	FERRY STREET BRIDGE	182.1	R	1170	STONE & ASPHALT	47	FCA (U)	N	1C	N/A	NONE
WR	TANNER RAPIDS	182.6	R	1950	STONE	35	EMERGENCY	N	3D	N/A	MAINTENANCE NOT AUTHORIZED
MF	DORRIS-LEONARD	187.0	R	2250	STONE	51	FCA (U)	N	3D,1B	N/A	NONE
MF	BOOTH-KELLY	190.8	R	2570	STONE	50	FCA (U)	N	3D,4D	N/A	NONE
MF	A. C. CLEARWATER	191.4	R	1980	STONE	49	FCA (U)	N	3D	N/A	NONE
MF	WILSON	192.0	R	3503	STONE	54	FCA (S)	Y	3C	N	SPONSOR HAS DISBANDED
MF	LAIRD	192.7	L	3689	STONE	54	FCA (S)	Y	3B	N	SPONSOR HAS DISBANDED
MF	NATRON	193.5	R	950	STONE & WOOD. BARR.	48	FCA (U)	N	3D	N/A	NONE
MF	FISHER	195.5	B	7900	STONE & LEVEES	58	FCA (S)	Y	3C,4B,4D	N	LEVEE/REVETMENT-BOTH BANKS
CA	HENSHAW	32.0	R	1622	STONE	53	FCA (S)	Y	N/A	Y	REVETMENT DESTROYED
CA	BROWNSVILL NO. 3	32.5	L	1988	CLASS III	65	FCA (S)	Y	3D	Y	SPONSOR ON DEFICIENT LISTING
CA	BROWNSVILLE NO. 2	33.2	R	875	STONE	51	FCA (U)	N	3A	N/A	NONE
CA	BROWNSVILLE NO. 1	33.5	R	1120	STONE	51	FCA (S)	Y	4D,3D	Y	SPONSOR ON DEFICIENT LISTING
RR	VEATCH (DORENA RES)	0.2	R	986	STONE	52	FCA (U)	N	3D	N/A	NONE
RR	HEMENWAY(DORENA RES)	0.5	L	1275	STONE	52	FCA (U)	N	1C	N/A	NONE

Table 2-11. List of bank protection structures associated directly or indirectly with USACE activities in the Willamette River basin.

River	Name	River Mile	Bank	Length	Structure Type	Year Constructed	Construction Authority	Maintenance Agreement	Maintenance Category	Maintenance Deficient	Comments
CR	PARK PLACE	1.5	L	630	STONE	54	FCA (S)	Y	1B	N	NONE
CR	SEMPLE ROAD	9.5	R	1515	CLASS III	62	FCA (S)	Y	1A	N	NONE
CR	SEMPLE ROAD U/S EXT	9.9	R	581	CLASS III	70	FCA (S)	Y	2C	N	NONE
CR	UPPER SEMPLE ROAD	10.3	R	1810	CLASS III	72	FCA (S)	Y	1A	N	NONE
CR	LOCATION NO. 12A	11.4	L	1240	STONE	38	FCA (U)	N	N/A	N/A	REVEMENT DESTROYED 64 FLOOD
CR	LOCATION NO. 13	12.7	L	520	STONE	38	FCA (U)	N	4D	N/A	NONE
CR	LOCATION NO. 14	12.8	R	1222	STONE	38	FCA (U)	N	N/A	N/A	REVEMENT DESTROYED
CR	BOAT RAMP	13.6	R	690	CLASS III	83	FCA (S)	Y	2A	N	NONE
CR	LOWER PARADISE PARK	19.0	R	2050	STONE	66	FCA (S)	Y	1B	N	NONE
CR	PARADISE PARK	19.9	R	1156	STONE	38	FCA (U)	N	1C	N/A	NONE
CR	TWIN ISLAND	20.1	R	990	CLASS III	77	FCA (S)	Y	1A	N	NONE
NS	HOLT	12.5	R	2635	CLASS III	82	LCA (S)	Y	3B	N	NONE
NS	EISENMANN	13.5	L	2391	CLASS III	70	FCA (S)	Y	3C	N	NONE
NS	SIDNEY DITCH	19.5	R	851	CLASS III	64	FCA (S)	Y	3D	N	NONE
NS	PRITCHARD	24.4	R	2660	CLASS III & IV	65	FCA (S)	Y	3C,3B	N	NONE
NS	LAFKY	26.2	R	1498	CLASS III	65	FCA (S)	Y	3B	N	NONE
NS	LOCATION 40	28.4	L	4370	LEVEE	46	EMERGENCY	N	4D	N/A	NONE
NS	STAYTON	28.5	R	1290	CLASS III	62	FCA (S)	Y	2B	N	NONE
NS	STAYTON ISLAND	30.0	R	1375	CLASS III	83	LCA (S)	Y	2B	N	NONE
MO	LOCATION NO. 1	2.9	L	1875	STONE	38	FCA (U)	N	3C	N/A	NONE
MO	LOCATION NO. 2	4.8	L	1858	STONE	38	FCA (U)	N	4C,3C	N/A	NONE
MO	WILKE	5.1	L	1233	CLASS III	75	FCA (S)	Y	3D	Y	SPONSOR ON DEFICIENT LISTING
MO	ISLAND PARK	5.4	R	1916	CLASS III	67	FCA (S)	Y	2C	Y	SPONSOR ON DEFICIENT LISTING
MO	GOODS BRIDGE	6.0	L	1698	CLASS III	81	FCA (S)	Y	3C	N	SPONSOR ON DEFICIENT LISTING
MO	LOCATION NO. 4	7.0	L	1980	STONE	38	FCA (U)	N	4D	N/A	NONE
MO	SERRES MAY	7.4	L	1360	CLASS III	82	FCA (S)	Y	3B	N	SPONSOR ON DEFICIENT LISTING
MO	LOCATION NO. 5	8.2	L	810	STONE	38	FCA (U)	N	4D	N/A	NONE
MO	LOCATION NO. 6	8.5	L	1087	STONE	38	FCA (U)	N	4D	N/A	NONE
MO	LOCATION NO. 7	9.0	L	710	STONE	38	FCA (U)	N	4D	N/A	NONE
MO	LOCATION NO. 8	9.5	L	1915	STONE	38	FCA (U)	N	4D,3B	N/A	NONE
MO	LOCATION NO. 10	10.4	L	1793	STONE	38	FCA (U)	N	1D	N/A	NONE

Table 2-11. List of bank protection structures associated directly or indirectly with USACE activities in the Willamette River basin.

River	Name	River Mile	Bank	Length	Structure Type	Year Constructed	Construction Authority	Maintenance Agreement	Maintenance Category	Maintenance Deficient	Comments
MO	LOCATION NO. 11	11.3	L	1131	STONE	38	FCA (U)	N	2C,3C	N/A	NONE
MO	LOCATION NO. 12	12.3	L	500	STONE	38	FCA (U)	N	N/A	N/A	REVEMENT DESTROYED
MO	OFFICER DLC	13.9	L	2468	CLASS III	70	FCA (S)	Y	3D,3A	Y	SPONSOR ON DEFICIENT LISTING
MO	RESSEL LOCATION	14.4	L	3079	STONE & LEVEE	51	FCA (S)	Y	3D,4D	Y	SPONSOR ON DEFICIENT LISTING
MO	SHADY DELL	20.2	L	1346	CLASS III	73	FCA (S)	Y	1A	N	NONE
CF	EVANS	1.3	R	1225	STONE	49	FCA (U)	N	4D,1C	N/A	NONE
CF	SEAVEY PROPERTY	2.4	R	1107	STONE	57	FCA (S)	Y	3D	Y	SPONSOR ON DEFICIENT LISTING
CF	SEAVEY BRIDGE	3.0	R	1300	STONE	50	FCA (U)	N	1D,4D	N/A	NONE
CF	SEAVEY LOOP	3.1	L	765	STONE	56	FCA (S)	Y	1D	Y	SPONSOR ON DEFICIENT LISTING
CF	MIKESELL(DORENA RES)	3.2	L	143	PLUG	52	FCA (U)	N	N/A	N/A	INACTIVE
CF	MCCULLY	3.6	B	3655	STONE	50	FCA (U)	N	3C	N/A	NONE
CF	GOSHEN	4.2	L	1030	STONE & GRAVEL APRON	44	EMERGENCY	N	3D	N/A	MAINTENANCE NOT AUTHORIZED
CF	LWR MELTON (DORENA)	9.0	L	1046	STONE	52	FCA (U)	N	3C	N/A	NONE
CF	MELTON (DORENA RES)	9.2	R	2350	STONE	51	FCA (U)	N	4D	N/A	NONE
CF	JENKINS (DORENA RES)	9.6	L	2692	STONE	51	FCA (U)	N	3C	N/A	NONE
CF	HASKINS (DORENA RES)	10.1	R	2020	STONE	51	FCA (U)	N	4C	N/A	2 SITES, 1380 LF & 640 LF
CF	SLY (DORENA RES)	10.7	L	890	STONE	52	FCA (U)	N	3C	N/A	2 SITES, 247 LF & 643 LF
CF	HAROLD	11.1	L	1660	STONE	52	FCA (U)	N	4C	N/A	NONE
CF	BENTER (DORENA RES.)	11.6	L	2000	STONE	51	FCA (U)	N	3C	N/A	NONE
CF	LOWER BENTER	11.4	R	1254	STONE	52	FCA (U)	N	3C	N/A	NONE
CF	RINEHART(DORENA RES)	12.1	R	2400	STONE	51	FCA (U)	N	4C	N/A	NONE
MR	WILSON BEND	0.8	R	2250	STONE & ASPHALT	46	EMERGENCY	N	4D	N/A	MAINTENANCE NOT AUTHORIZED
MR	BLANKTON	5.8	R	4125	STONE & WOOD. BARR.	51	FCA (U)	N	4D,3D	N/A	NONE
MR	ARMITAGE PARK	7.0	L	1411	CLASS III	78	FCA (S)	Y	1A	N	NONE
MR	HARLOW	6.7	L	1943	CLASS III & W. BARR.	60	FCA (S)	Y	4D	N	NONE
MR	COBURG BRIDGE	7.1	R	1349	STONE	47	FCA (U)	N	4D,3D	N/A	NONE
MR	ARMITAGE	8.3	L	1539	STONE & STEEL BARR.	38	FCA (U)	N	3D	N/A	NONE
MR	ARMITAGE U/S EXT	8.5	L	2353	STONE	58	FCA (S)	Y	3D	N	NONE
MR	CONLEY PLACE	10.3	L	4250	STONE	47	FCA (U)	N	3D	N/A	NONE
MR	CONLEY PLACE U/S EXT	10.8	L	2473	STONE	58	FCA (S)	Y	1B,3B	N	SPONSOR ON DEFICIENT LISTING
MR	CHASE	11.3	L	1473	CLASS III	61	FCA (S)	Y	4D,3B	N	SPONSOR ON DEFICIENT LISTING

Table 2-11. List of bank protection structures associated directly or indirectly with USACE activities in the Willamette River basin.

River	Name	River Mile	Bank	Length	Structure Type	Year Constructed	Construction Authority	Maintenance Agreement	Maintenance Category	Maintenance Deficient	Comments
MR	KEPNER	12.9	L	2057	CLASS III	63	FCA (S)	Y	3A	N	NONE
MR	MYERS-EYLER D/S EXT	15.4	L	1432	STONE	58	FCA (S)	Y	1B	N	NONE
MR	MYERS-EYLER	15.7	L	2688	STONE	49	FCA (U)	N	1D	N/A	NONE
MR	LOWER BARNET	17.6	L	3484	CLASS III	61	FCA (S)	Y	4D,2D	Y	SPONSOR ON DEFICIENT LISTING
MR	MORRISS	19.5	L	2785	STONE & WOOD. BARR.	54	FCA (S)	Y	3D	Y	SPONSOR ON DEFICIENT LISTING
MR	BURNUM	20.6	L	2296	CLASS III & W. BARR.	60	FCA (S)	Y	4D,3D	Y	SPONSOR ON DEFICIENT LISTING
MR	THURSTON	21.1	L	2646	STONE	51	FCA (U)	N	4D	N/A	NONE
MR	GREEN	21.3	R	1838	STONE & WOOD. BARR.	60	FCA (S)	Y	3D	Y	SPONSOR ON DEFICIENT LISTING
MR	HART	22.1	L	2573	STONE	50	FCA (U)	N	3C	N/A	NONE
MR	HART U/S EXT	22.3	L	268	CLASS III	70	FCA (S)	Y	3C	N	NONE
MR	STOCKADE	22.7	R	2848	STONE	51	FCA (U)	N	4D,3D	N/A	NONE
MR	CEDAR FLATS	23.1	L	1970	STONE	47	EMERGENCY	N	4D	N/A	MAINENANCE NOT AUTHORIZED
MR	WALTERVILLE LOC	24.6	R	2235	CLASS III & LEVEE	66	FCA (S)	Y	3D	N	2235 LF STONE & 2989 LF LEVEE
MR	HUCKA	29.2	R	1866	CLASS II	63	FCA (S)	Y	3C	N	NONE
MR	OTWELL	38.0	R	692	CLASS II	66	FCA (S)	Y	1A	N	NONE
MR	LEABURG DAM GROINS	38.8	L	580	5 STONE GROINS	58	FCA (S)	Y	3B	N	NONE
MR	LEABURG DAM GROINS	38.8	R	900	4 STONE GROINS,EMB.	58	FCA (S)	Y	3B	N	TOTAL SITE LENGTH IS 1480 LF
SR	TURNIDGE	0.3	R	1250	STONE	48	FCA (U)	N	4D	N/A	NONE
SR	LOCATION NO. 2	0.8	L	3250	STONE	39	FCA (U)	N	4D,3B	N/A	NONE
SR	LOCATION NO. 3	1.3	R	3630	STONE, W. & ST. BARR	44 & 54	FCA (U) & (S)	Y	3B	N	SPONSOR - DRIFT BARRIER
SR	KREBS PROPERTY	1.8	R	471	STONE & STEEL. BARR.	58	FCA (S)	Y	3D	N	NONE
SR	LOCATION NO. 4	1.9	R	1939	GRAVEL	39	FCA (U)	N	N/A	N/A	REVETMENT DESTROYED
SR	LOCATION NO. 4	2.1	R	1370	STONE	67	FCA (S)	Y	3B	N	NONE
SR	WILFERT	2.4	L	2700	STONE	51	FCA (U)	N	3B	N/A	NONE
SR	LOWER W'MANTEL	2.8	R	1567	CLASS III	61	FCA (S)	Y	3D	N	NONE
SR	WINTERMANTEL	3.2	R	1800	STONE	50	FCA (U)	N	4D	N/A	NONE
SR	EDWARDS	3.3	L	1763	CLASS III	65	FCA (S)	Y	3C	N	NONE
SR	TOMASEK	4.6	R	2154	CLASS III	55	FCA (S)	Y	3B	N	NONE
SR	TOMASEK U/S EXT.	5.2	R	1878	STONE	76	FCA (S)	Y	3B	N	NONE
SR	CROWN-WILLAMETTE	5.3	L	2803	STONE & WOOD. BARR.	55	FCA (S)	Y	3D	N	NONE
SR	MILLAR	6.2	R	3890	STONE	48	EMERGENCY	N	3D	N/A	MAINTENANCE NOT AUTHORIZED

Table 2-11. List of bank protection structures associated directly or indirectly with USACE activities in the Willamette River basin.

River	Name	River Mile	Bank	Length	Structure Type	Year Constructed	Construction Authority	Maintenance Agreement	Maintenance Category	Maintenance Deficient	Comments
SR	BANICK D/S EXT	7.2	L	2024	CLASS III	67	FCA (S)	Y	3C	N	NONE
SR	BANICK DRFIT BARRIER	7.4	L	1220	STEEL. BARR.	48	FCA (U)	N	3D	N/A	NONE
SR	MALONE	7.5	L	1899	CLASS III	63	FCA (S)	Y	3C	N	NONE
SR	WICKHAM	8.3	R	4650	STONE	50	FCA (U)	N	2D	N/A	NONE
SS	BRYANT	0.9	L	2974	CLASS III	60	FCA (S)	Y	4D	N	NONE
SS	UPPER BRYANT	1.4	L	1619	CLASS III	74	FCA (S)	Y	4D,3C	N	NONE
SS	SPRING BRANCH	2.0	R	1910	CLASS III	63	FCA (S)	Y	4C	N	NONE
SS	ADKINS	2.2	L	1459	CLASS III	72	FCA (S)	Y	1C	N	NONE
SS	DEWALL	2.8	R	1305	STONE	57	FCA (S)	Y	4D	N	NONE
SS	LOWER BLAKELEY	3.1	L	1632	CLASS III	67	FCA (S)	Y	3D	N	NONE
SS	BLAKELEY	3.4	L	1195	STONE	53	FCA (S)	Y	4D	N	NONE
SS	TRIPP	3.5	R	3330	STONE & WOOD BARR.	51	FCA (U)	N	3D	N/A	NONE
SS	CRENSHAW	4.0	L	1226	STONE	53	FCA (S)	Y	4D	N	NONE
SS	COX	5.0	B	13460	3 STONE REVETMENTS	53	FCA (U)	N	3C	N	NONE
SS	COX U/S EXT	5.1	R	1780	CLASS III	59	FCA (S)	Y	3C	N	NONE
SS	WILKINSON	5.4	L	2416	CLASS III	60	FCA (S)	Y	4D,3B	N	NONE
SS	PETERSON	5.9	R	1658	CLASS III	62	FCA (S)	Y	4D,3D	N	NONE
SS	HAYES D/S EXT	6.3	L	2137	CLASS III	67	FCA (S)	Y	3C	N	NONE
SS	HAYES	6.5	L	1465	STONE	58	FCA (S)	Y	3C	N	NONE
SS	BARCLAY	7.3	R	1449	CLASS III	60	FCA (S)	Y	3B	N	NONE
SS	SANDERSON BRIDGE	7.7	L	2244	STONE	45	FCA (S)	Y	1B,3D	N	NONE
SS	POWELL	8.1	L	1985	CLASS III	65	FCA (S)	Y	3D	N	NONE
SS	PAPE D/S EXT	8.2	R	1080	CLASS III	59	FCA (S)	Y	4D	N	NONE
SS	PAPE	8.2	R	1807	STONE	51	FCA (U)	N	4D	N/A	NONE
SS	KETCHAM D/S EXT	8.8	L	2331	CLASS III & W. BARR.	68	FCA (S)	Y	4D	N	NONE
SS	KETCHAM	9.2	L	2225	STONE	51	FCA (U)	N	4D	N/A	NONE
SS	COLDSPRING D/S EXT	11.0	R	1050	CLASS III & IV	68	FCA (S)	Y	3A	N	NONE
SS	COLDSPRING	11.2	R	3081	CLASS III & W. BARR	61	FCA (S)	Y	4D	N	NONE
SS	GUNDERSON	12.1	R	3395	STONE	57	FCA (S)	Y	4D,3A	N	NONE
SS	SWINK	13.1	R	1468	CLASS III	61	FCA (S)	Y	3B	N	NONE
SS	SWINK U/S EXT	13.4	R	840	CLASS III	71	FCA (S)	Y	3A	N	NONE

Table 2-11. List of bank protection structures associated directly or indirectly with USACE activities in the Willamette River basin.

River	Name	River Mile	Bank	Length	Structure Type	Year Constructed	Construction Authority	Maintenance Agreement	Maintenance Category	Maintenance Deficient	Comments
SS	EAGLE	13.7	L	1917	STONE	54	FCA (S)	Y	3B	N	NONE
SS	KOWITZ	14.0	R	3007	CLASS III & W. BARR	61	FCA (S)	Y	3C	N	NONE
SS	MCCORMICK	16.0	L	2618	CLASS III	59	FCA (S)	Y	3A	N	NONE
SS	DANGERFIELD	16.6	L	1302	CLASS III & ST. BARR	62	FCA (S)	Y	4C	N	NONE
SS	SANTIAM LUMBER CO.	18.7	L	2055	STONE	49	EMERGENCY	N	4D	N/A	MAINTENANCE NOT AUTHORIZED
SS	LANDSTROM	19.1	L	2179	CLASS III	59	FCA (S)	Y	2D	N	NONE
SS	COOK	19.7	L	2129	STONE	47	EMERGENCY	N	1D	N/A	MAINTENANCE NOT AUTHORIZED
SS	STRINGER	29.1	L	3976	CLASS III	62	FCA (S)	Y	1A	N	NONE

River

WR - Willamette River
MF - Middle Fork Willamette River
CF - Coast Fork Willamette River
CR - Clackamas River
SR - Santiam River
NS - North Santiam River
SS - South Santiam River
ML - Molalla River
MR - McKenzie River
CA - Calapooia River
RR – Row River

Construction Authority

FCA (S) - Flood Control Acts (Sponsored Projects)

FCA (U) - Flood Control Acts (Unsponsored Projects)

R&H - River and Harbors Acts

Emergency - Emergency Bank Protection Projects

Maintenance Category

1 - High Value - High Risk (structures 0' to 75' from river bank)
2 - High Value - Low Risk (structures > 75' from river bank)
3 - Low Value - Low Risk (revetment under attack)
4 - Low value - No Risk

A - Cleared revetment or grass cover only
B - Combined grass, shrub and brush cover
C - Shrub and tree cover
D - Predominantly tree cover

Maintenance Deficient

Y - Yes
N - No
N/A - Not applicable

Maintenance Agreement

Y – Yes
N – No

2.13 MONITORING PROGRAMS

There are presently no specific USACE fisheries monitoring programs designed to evaluate effects of any of the thirteen Willamette projects. The USACE is currently funding research into Oregon chub habitat, life history, and population restoration.

The ODFW is presently conducting studies of downstream passage of juvenile salmonids through turbines at Cougar Dam. Passage of adult and juvenile salmon at Cougar Dam was judged to be infeasible by the Oregon Fish Commission after two years of study, leading to the abandonment of fish passage as an objective and instead relying on artificial propagation as mitigation. The ODFW initiated a new study of downstream passage in 1998 to monitor number, size, and mortality rate of fish passing through the turbines and regulating outlet of Cougar Dam.

The ODFW is also monitoring movement of radio-tagged adult bull trout in the Cougar and Hills Creek reservoirs, including passage downstream of the dams (Taylor and Reasoner 1998).

2.14 EMERGENCY ASSISTANCE PROGRAM

Willamette Project operations are influenced by the Emergency Assistance Program under Public Law 84-99. Table 2-12 lists the variety of activities and types of assistance that the USACE may provide in association with flood control and bank protection works. Activities that most directly influence listed species include assisting with emergency bank reconstruction work, and preparation for anticipated, unusually large flood events.

Table 2-12. Willamette Project activities related to emergency assistance under PL 84-99.

Category	Feature	Type of Assistance	Eligibility Criteria	Delegated Authority	
				District	Division
WATER ASSISTANCE CODE 400	Field investigate	• Investigate eligibility and prepare report	• Written request	$10K per investigation	$50K per investigation
	Assistance due to contaminated source	• Provide clean supply of water	• Contaminated source • Threat to public health and welfare • Supplemental to state and local resources • Governor's written request • 30 day limitation	None	$100 per project
	Assistance due to drought	• Well drilling on a reimbursable basis • Transportation of water at federal expense	• Designation by Secretary of Army of drought distressed area • Water for human consumption only • Applicants may be farmers, ranchers, or political subdivisions through local government		Project requires HQUSACE approval
ADVANCE MEASURES CODE 500	Field Investigation	• Investigate eligibility and prepare report	• Written request from the Governor	$10K per situation	$50K per investigation
	Project	• Preventative work performed prior to predicted unusual flooding • Applications for ice jam removal, snowmelt flooding, potential dam failure or special cases at the discretion of Director of Civil Works	• Prediction of unusual flooding by NEW or USACE • Threat to life or improved property • Complements maximum state and local efforts • Work completed in time to prevent damages • Technically feasible/economically justified • Removal or upgrades performed by sponsor	None	Project requires HQUSACE approval
HAZARD MITIGATION CODE 600	Team Member	• Identification of post-flood mitigation opportunities • Establish framework for recovery	• Presidentially declared major disaster • Activation of Hazard Mitigation Team by FEMA	None	$10K per team activation
ARMY REGULATION 500-60	Emergency Response to any Disaster	• Emergency relief effort (debris clearance, etc) • Establish framework for recovery	• Life saving • No contract personnel or equipment • Usually no reimbursement	No monetary limit Commander's own discretion	No monetary limit Commander's own discretion

Table 2-12. Willamette Project activities related to emergency assistance under PL 84-99.

Category	Feature	Type of Assistance	Eligibility Criteria	Delegated Authority	
				District	Division
Emergency Assistance Under PL 93-288					
PUBLIC LAW 93-288	Disaster response	• Damage assessment • Emergency electrical power • Engineering for search and rescue • Repair critical public utilities • Provide emergency water • Clear critical access routes	• Presidentially declared major disaster or activation by FEMA Regional Director • Mission assignments	Funds negotiated for each mission assignment	Funds negotiated for each mission assignment
	Disaster recovery	• Damage survey reports • Debris removal • Temporary utilities and facilities			
DISASTER PREPAREDNESS CODE 100	Planning	• preparation for quick and effective response to emergencies	• Division and district disaster preparedness programs are funded annually according to organizational requirements	Annual budget	Annual budget
	Training and exercises	• maintain organization capable of responding quickly			
	Supplies	• stockpile critical flood fight materials			
	Public Assistance	Liaison, coordination, and inspection activities			

Table 2-12. Willamette Project activities related to emergency assistance under PL 84-99.

Category	Feature	Type of Assistance	Eligibility Criteria	Delegated Authority	
				District	Division
EMERGENCY OPERATIONS CODE 200	Field investigation	• Field reconnaissance of flood potential	• Special conditions of unusual concern	$10K per situation	$500K per situation
	Flood response	• Technical assistance • Assist in rescue operations • Furnishing flood fight materials • Contracting for emergency construction	• Supplemental to state and local resources • Temporary in nature • Subordinate to local responsibility • Removal of work by local sponsor • No assistance to individuals • No reimbursement to local interests	$100K per event	$500K per event division wide
	Post flood response	• Technical assistance • Emergency debris removal • Temporary restoration of critical transportation routes or public services/facilities	• Requires written request from the Governor concurrent with request for PDA by FEMA • Limited to life threatening situations • Limited to 10 days from date of request	$100K per event	$500 per event division wide
	After–Action report	• Summarizes disaster operations • Evaluates strengths and weaknesses • Recommends corrective actions	• Report required whenever District delegated authority exceeded in any Code 200 feature	$10K per event	$25K per event division wide
REHABILITATION CODE 300	Field investigation	• Investigate eligibility and prepare report	• Written request from a public entity	$10K per investigation	$50K per investigation
	Project	• Repair any flood control work • Repair only federally constructed hurricane or shore protection work	• Must be damaged by flood or coastal storm • Project must provide dependable and effective flood control system • Restoration to pre-disaster condition (Modification may be authorized) • Economically justified/maintenance deficiencies is local responsibility • 30% - 20% cost share for non-federal projects	None	$500K per event division wide